NATURAL PROPAGATION AND HABITAT IMPROVEMENT

VOLUME I - OREGON

FINAL AND ANNUAL REPORTS, 1982/1983

Published by

Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
April, 1984

VOLUME I

OREGON

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FISH/WASH CREEK HABITAT IMPROVEMENT

ANNUAL REPORT, 1983

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Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP11968
Project No. 83-385
Project Officer: Larry Everson

FISH/WASH CREEK HABITAT IMPROVEMENT
FY '83 ACCOMPLISHMENT REPORT

ABSTRACT

Fish Creek and its major tributary, Wash Creek, are regarded by ODFW as one of the largest producers of anadromous salmonids in the upper Clackamas River. The fish habitat quality of Fish and Wash Creeks is believed lowered by a lack of large structure which is responsible for the scarcity of quality pools and spawning habitat. Smolt habitat capability is limited for spring chinook, coho salmon, and summer and winter steelhead by low amounts of spawning and rearing habitat and also by summer water temperatures, which are above the optimum for these species.

The Fish Creek/Wash Creek habitat improvement project is a five-year effort to maximize the natural production of spring chinook, coho salmon, and summer and winter steelhead trout, and to evaluate habitat changes and smolt production as a result of habitat improvement in the Fish Creek drainage. The first year (FY '83) objectives of the project were (1) to increase the amount of quality rearing habitat for coho salmon in lower Fish Creek, (2) to increase the quantity of spawning habitat for summer and winter steelhead trout in lower Wash Creek and for spring chinook salmon in lower Fish Creek and, (3) to increase stream surface shading and bank cover in selected riparian sites.

A total of 14 boulder berms were constructed in September 1983 to recruit an expected 350 yd^2 of gravel for spawning habitat. Also, a 700-foot pipe was laid to divert water from Fish Creek into an intermittent pond to create a permanent one-acre pond for rearing coho salmon. An outlet was also constructed for the pond, allowing fish access. Riparian planting sites were identified and are expected to be planted in the spring of 1984. The Fish Creek Evaluation completed its second field season, incorporating these new improvements into the study. While the cost of individual items varied, the project is being accomplished within the original total budget estimate.

Fish Creek/Wash Creek Habitat Improvement Project

Annual Report FY '83

Agreement No. DE AI79 83BP11968

Estacada Ranger District

Mt. Hood National Forest

Introduction

Fish Creek, a tributary to the Clackamas River, is one of the most important contributors to the natural anadromous fish production of the upper system. Fish and Wash Creek are high energy Cascade streams which, for a variety of reasons, lack large structure in many areas. This lack of large structure is believed to be responsible for a scarcity of quality pool (rearing and overwintering) or spawning habitat. Smolt habitat capability for coho salmon is estimated to be limited to about 20 percent of potential on lower Fish Creek by a lack of suitable rearing habitat. Smolt production for summer and winter steelhead trout is limited to about 50 percent of potential on lower Wash Creek by a lack of spawning habitat. Habitat capability for spring chinook salmon is limited to about 40 percent of potential on lower Fish Creek by a lack of suitable spawning habitat. Overall, smolt habitat capability is limited by high summer water temperatures. Correcting these deficiencies through the proposed five-year project offers the opportunity to substantially increase the natural fisheries production potential of Fish Creek.

The Fish Creek/Wash Creek habitat improvement project is a five-year effort to maximize the natural production of spring chinook, coho salmon, and summer and winter steelhead trout, and to evaluate habitat changes and smolt production as a result of habitat improvement projects in the Fish Creek drainage. The first year (FY '83) objectives of the project were (1) to increase the amount of quality rearing habitat for coho salmon in lower Fish Creek, (2) to increase the quantity of spawning habitat for summer and winter steelhead trout in lower Wash Creek and for spring chinook salmon in lower Fish Creek and, (3) to increase stream surface shading and bank cover in selected riparian sites.

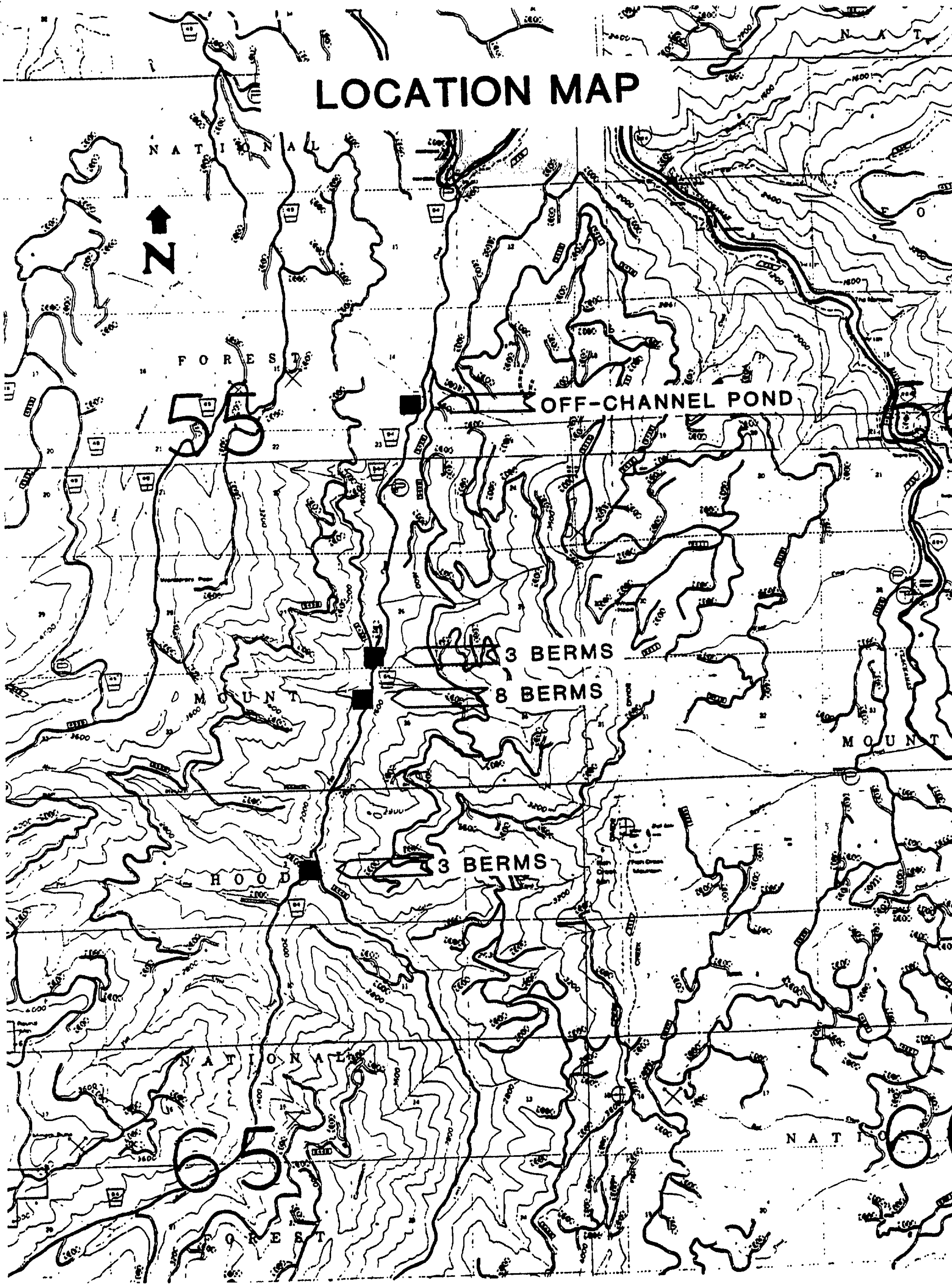
Description of Study Area

Fish Creek is a high energy tributary to the Clackamas River, with its confluence about nine miles upstream of the North Fork Reservoir. Approximately 11 miles of habitat suitable for spring chinook, coho salmon, and summer and winter steelhead trout are currently available in the drainage. Three and one-half miles of this habitat are found in Wash Creek, the major tributary to Fish Creek. The Oregon Department of Fish and Wildlife regards the drainage as one of the largest producers of salmon and steelhead in the upper Clackamas River system. Over the last five years approximately $100,000 of FS funds have been invested in a variety of habitat enhancement projects including a spawning habitat improvement project (five structures) completed in FY '82 and another project (six structures) completed in FY '83. Additionally, a comprehensive, drainage-wide evaluation of habitat enhancement projects jointly funded by USDA Forest Service and BPA is in its second year. It is being conducted by Drs. Fred Everest and Jim Seddell of the Forest Service's research branch, the Pacific Northwest Forest and Range Experiment Station (PNW).

Methods and Materials

1. Rearing habitat improvement on lower Fish Creek involved the re-establishment of an intermittent side channel pond. The pond is isolated from and elevated approximately five feet above the level of the main channel. It is filled with water from an intermittent tributary in winter and spring but goes dry during the remainder of the year. A

LOCATION MAP



diversion pipe was laid from a point more than 700 feet upstream to provide a gravity flow, low maintenance diversion that will provide a regulated flow in summer and fall. Construction of an outlet control structure for the pond regulates flows back to Fish Creek, and allows fish passage in and out of the pond. More than 4,800 sq. yards of high quality rearing habitat for coho salmon and overwintering habitat for steelhead will be provided. A construction contract for the diversion pipe was awarded with an estimated cost of $18,000.

2. Spawning habitat improvement involved the construction of boulder berms in the main channel of Fish and Wash Creeks. Sites were chosen on the basis of gradient, channel sinuosity, and on-site supply of boulders. The berms were designed to trap portions of the ample bedload moving through the stream at high flows. A large track-mounted backhoe was moved into the stream channel and rearranged the boulder/cobble/rubble material into a V-shaped berm (see photos). Although instream enhancement in high energy streams such as Fish and Wash Creeks is rather difficult, the feasibility of this design was demonstrated through initial installation of five boulder berms with USDA Forest Service funds in FY '82. Three boulder berms were installed on Wash Creek at RM (river mile) 0.2, creating 75 sq. yards of spawning gravel and should be utilized by summer and winter steelhead trout. On Fish Creek, eight boulder berms were installed at RM 4.7, creating 200 sq. yards of spawning gravel which will more than double the spawning habitat available to spring chinook salmon (also likely being utilized by steelhead). A contract for equipment and operator rental was let in September at a final cost of $5,117.00. The average cost per structure was $365.00.

3. Riparian planting will be done in selected area. Approximately four miles of mainstem Fish Creek and tributaries have had partial or complete removal of shading vegetation in the last 25 years. Revegetation of the riparian zone has occurred slowly. Deciduous vegetation and conifers are becoming established in most areas. However, the orientation and size of the stream channel generally require tall vegetation for effective stream shading. Summer stream temperatures have been recorded up to 70° in recent years. Riparian planting with selected species will hasten the reduction of summer water temperatures and increase species diversity within the riparian zone. Planting was delayed until the spring of 1984 to improve survival of plantings.

4. The Fish Creek Evaluation is completing its second year. The Evaluation is looking at changes in fish production and physical habitat from a drainage-wide perspective. Their annual report is being submitted under separate cover.

Results and Discussion

1. Although money was not committed until May 1983, and the project is believed to be the first of its kind in Region 6, the off-channel diversion pipe construction contract was awarded in September and completed in November 1983. Approximately 700 feet of 4-inch diameter pipe was laid on a minus 0.5% grade from a pool in Fish Creek to a point approximately 200 feet upstream of the pond (see photos). The pipe was fitted with a control valve.

Problems encountered in the planning stage were the uniqueness of the project and therefore the additional work required to assure 1) feasibility of the concept, 2) inlet design, and 3) design pipe length. Consultants from British Columbia were brought in who had practical experience in developing side channel enhancement projects. Their input greatly helped resolution of design questions.

Problems encountered in the construction stage were: 1) delay in materials delivery, 2) discovery of a cultural resource site that necessitated survey and protection, 3) bedrock in the area of excavation along the streambank that required blasting, 4) valve design, and 5) the late start for construction. In spite of good early fall weather, construction delays forced construction activities into the rainy season, causing additional costs for road rocking.

2. The boulder berm construction contract was accomplished using an hourly rental agreement for backhoe and operator. The contract was awarded in August and construction completed in September 1983. Construction was directed by the District Fish Biologist. The project work was funded with both BPA and a Forest Service KV habitat improvement money. A total of 20 structures were built, six with KV funds and 14 with BPA funds. Construction time was two-thirds of that expected, providing us with the opportunity to build an additional three berms. The site had particularly easy access and allowed us to experiment with wing deflectors which extend from the right bank to mid-channel.

   As planned, eleven boulder berm structures were built in lower Fish Creek (see photos). Equipment access was limited to one streamside entry point, virtually eliminating any bank disturbance. Three boulder berms were built in lower Wash Creek. These structures were originally planned as gabions, but were changed to berms because of the cost savings ($2600/structure) in construction. It is anticipated that, on the average, 25 sq. yards of high quality spawning gravel will accumulate at each structure. The eleven structures on Fish Creek will provide 275 sq. yards of spawning gravel for spring chinook, an increase of 183%. The three structures on Wash Creek will provide 75 yds^2 of steelhead gravels, an increase of 50%.

   There were no significant problems encountered with either planning or construction of the berm structures.

3. Riparian planting sites have been identified in the Fish Creek drainage. A total of four acres will be planted this spring, which was reduced from an original estimate of 15 acres. Upon field evaluation, other sites where stream shading is disturbed cannot realistically be enhanced by additional plantings. These sites have naturally revegetated with alder, willow, vine maple, cedar, hemlock, and Douglas-fir. Reforestation of clearcuts with Douglas-fir has occurred along streamsides as well.

4. The Fish Creek Evaluation was continued for the second year. Fish population sampling occurred at 38 locations within the drainage. Redd counts were made for steelhead trout and chinook salmon as weather and streamflow permitted. Additional physical habitat data was collected at

project sites before and after construction. A smolt trap was built at the outlet structure of the off-channel rearing pond to monitor movements into and out of the pond. Evaluation of riparian planting will not begin until FY '84. This reduced FY '83 costs by $5,000 from original estimates.

5. Berm construction costs were less than originally estimated and the off-channel rearing pond diversion costs were somewhat higher. All work was completed within the amount originally requested from BPA.

Summary and Conclusions

A majority of contract tasks have been completed in the first nine months of the project. This includes establishment of more than an acre of high quality coho rearing habitat (off-channel development). Water can now be directed into the pond from Fish Creek in summer and fall and both juvenile and adult fish can migrate between the pond and Fish Creek. Fourteen boulder berm structures designed to create 350 to 400 yd^2 of additional spawning habitat were built; this is three more structures likely providing 75-80 yd^2 spawning habitat more than originally proposed. Observation of these projects during winter flood flows indicated the structures were performing well. Following winter flood events, minor maintenance work may be necessary in FY '84. Riparian planting will be done in the spring of 1984. The area to be planted has been reduced, but should not compromise the recovery of stream shading or the objective of lowering summer water temperatures. The Fish Creek Evaluation completed its second season, expanding its scope to include the enhancement projects funded by BPA. While costs varied from original estimates for individual projects, the overall budget was within the amount originally requested from BPA.

BUDGET

I. Habitat Improvement Budget

A.	Personnel	$11,268.56
B.	Travel/Per Diem	921.65
C.	Equipment/Supplies	
	Expendable	481.07
Subtotal (A+B+C)		12,678.28
D.	Administrative Overhead	2,398.23
E.	Contract Costs	
	1. Fish Creek Off-channel Rearing Pond	24,030.63
	2. Wash Creek Gravel Recruitment Structures (included in numbers)	
	3. Lower Fish Creek Gravel Recruitment Structures	5,117.23
	4. Riparian Plantings (Spring of 1984)	*
Subtotal (D+E)		29,147.86
Phase I Funding		44,217.37

II. Habitat Evaluation Budget

Phase II Funding	30,000.00
Total Spent to Date	$74,217.37

* Riparian plantings programmed for Spring 1984 (to assure planting success) estimated to be (total left to spend): 4,383.00

TYPICAL CONSTRUCTION OF A BOULDER BERM

Backhoe moving 3 foot diameter boulder into position.

Backhoe constructing primary row of boulders of arm of boulder berm. Largest boulders in the reach of stream are used for this row.

Secondary rows of large boulders are placed upstream and downstream of primary row of arm of boulder berm.

Arm of boulder berm completed.

Rip-rap of stream bank at access into Fish Creek.

View of pond area from ground level during dry period of the year.

View of pond area from ground level during wet period of year, after completion of project work. Ponded water covers a 1 acre area from 2-5 feet deep.

Outlet of 4" diameter pipe (valve closed). Pipe provides up to 1.5 cfs of additional flow. From this outlet, water flows for 200 feet in an old stream channel to the pond.

Preproject condition on lower Fish Creek looking downstream. Absence of large structure on this high energy stream is believed to be responsible for lack of quiet pool water or collection of spawning gravel.

Post project condition on lower Fish Creek. Series of six boulder berms were utilized to create large pools necessary to trap spawning gravels. Approximately 25 sq. yards of gravels are anticipated to accumulate at each structure.

Lower Fish Creek during first winter storm. Berms provide little resistence to flood flows, yet continue to pool water upstream of structures.

Close-up of boulder berm during winter storm. Note wave created by berm. Area of scour (whitewater) is 4 to 6 feet downstream of berm.

Lower Fish Creek pool area prior to project. Spawning habitat is patchy and limited by numerous boulders.

Same site following project completion. Pool area expanded by moving pool control downstream and increasing its height by placement of boulder berm. Altered hydraulics will likely to result in improved spawning habitat.

HOOD RIVER PASSAGE

ANNUAL REPORT, 1983

By

Jim Newton, Fishery Biologist
Oregon Department of Fish and Wildlife
Portland, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP11990
Project No. 83-341
Project Officer: Dale Johnson

Abstract

The initiation of the Hood River (Lake Branch) Fish Passage improvement project was delayed in the BPA Contracting Office until June 1983. Four prospective consultants were given a tour of West Fork (Moving) Falls site in August. Rittenhouse-Zeman and Associates were selected to prepare a feasibility report for waterfall stabilization. Two reports were received from the consultant by early December. A third, more detailed report is now being prepared.

Introduction

This project was initiated to evaluate Moving Falls on the West Fork Hood River to determine if a migrating rock formation could be stabilized and long-term fish passage provided. The removal of a partial migration barrier located further up-stream on lower Lake Branch Creek. Correction of the two fish passage problems should provide for full utilization of the West Fork Hood River system for summer steelhead.

Project Area Description

Moving Falls is located near the center of section 14, Town-ship 1 North, Range 9 East Willamette Merridian. The falls are located about 1.8 miles downstream (northeast) from the Lost Lake Road bridge over the West Fork Hood River. The site is near the community of Dee and is characterized by a broad, flat river channel, narrowing at the site of the falls. During high stream flow the upstream flood plain width is approximately 100 feet and downstream approximately 60 feet wide.

Approximately ten years ago a small waterfall developed downstream from the site and began a fairly rapid regression. Attempts were made by the Department of Fish and Wildlife to stabilize or prevent the erosion by filling with boulders and reducing the gradient by blasting. The falls are now at a height that prevents upstream migration of all but a few fish.

Results of 1983 Activities

Rittenhouse- Zeman and Associates, Geotechnical Consultants were selected to identify the erosional mechanisms that created the falls and submit alternatives and estimated costs for stabilizing them. Two reports, Phase I and Phase II, were conpleted and submitted to the Oregon Department of Fish and Wildlife in early December.

The Phase I Report summarized field explorations and studies relating to the underlying mechanism of the falls regression. Based on these studies it was concluded that the lower reach of the stream has eroded through a resistant layer of volcanic ash and is now cutting deeply into a less resistant layer of sand and gravel.

The Phase II Report consisted of a catalog of eight design solutions, each capable of providing some measure of formation stability. More that 20 individual designs were considered in preparation of this report. A number of engineering variations are possible on each of the eight general solutions sited.

Summary

Based on the reports prepared by the geotechnical consultant it appears that there are several feasible engineering solutions to stabilizing this unstable rock formation and hence the waterfall.

The partial barrier on Lake Branch Creek was not addressed during 1983. It was decided that a decision on action at this site would be delayed until it was determined there was a feasible solution to the passage problem downstream on the West Fork Hood River.

Expeditures

The only expediture obligated during the year was $10,000 for the consultant services.

RITTENHOUSE-ZEMAN & ASSOC.
GEOLOGY & SOILS ENGINEERING
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13837 N.E. 8th STREET • BELLEVUE, WASHINGTON 98005 • (206) 746-8020

November 9, 1983 0-2830

State of Oregon
Department of Fish & Wildlife
506 S. W. Mill Street
P. O. Box 3503
Portland, Or. 97208

Attn: Folkert Menger

Subject: Feasibility Study
Hood River Falls Stabilization/Phase I
Hood River County, Oregon

Gentlemen:

In accordance with our contract dated October 4, 1983 we are submitting our Phase I report on the subject project.

1.0 PURPOSE AND SCOPE

The purpose of this study is to identify the erosional mechanisms that has created the falls and submit alternatives and estimated costs for stabilizing them. The State will be responsible for creating a fish passage if the stabilization procedures result in excessive falls heights.

As outlined in our proposal, this Phase I report summarizes our field explorations and studies relating to the underlying mechanism of the falls regression. Based upon our studies it is our conclusion that the lower reach of the stream has eroded through a resistant layer of volcanic ash and is now cutting deeply into a less resistant layer of sand and gravel. Phase II of our study, consisting of a catolog of design solutions will be available in two weeks.

2.0 SITE DESCRIPTION

The site is located in T.1N., R.9E., near the center of Sec. 14. The falls are about 1.8 miles downstream (northeast) from the Lost Lake Road bridge over the river. The site is characterized by a broad, flat river channel, narrowing at the site of the falls. At the time of our field work, the falls were approximately 10 feet high and the pool below them approximately 15 feet deep. The stream above the falls is about 60 feet wide and only a few feet deep. The stream below the falls is about 25 feet wide and four to eight feet deep. During high water the upstream floodplain width appears to be about 100 feet wide and downstream approximately 60 feet wide.

Judging from the materials on the surface, the high velocity bed load of the stream includes boulders up to six feet in diameter. Any stabilization machanism or structure would have to withstand the impact of these materials rolling over, or bouncing upon, it.

3.0 BACKGROUND

Several years ago a small waterfall developed downstream from the site and began a fairly rapid regression. Attempts were made by the Department of Fish & Wildlife to stabilize or prevent the erosion by filling with boulders and reducing the gradient by blasting. The falls are now at a height that prevents upstream migration of all but a few fish, primarily steelhead and chinook.

4.0 GEOLOGY

The surficial geologic units within this area are mostly of the Cascades Formation volcanic rock. They consist of basaltic and andesitic flow rock, agglomerate, tuff breccia and debris flows, with some relatively young intracanyon flows. The age of these materials is approximately 35,000$^{\pm}$ years. This formation accounts for most of the visible soil and rock around the project area. A large lava flow apparently blocked the river about one mile downstream, creating a natural dam. An intracanyon debris flow partially filled the lake. Materials exposed in the river banks give a cross-section of these flows.

The older rocks, underlying the Cascades Formation, vary from place-to-place in Hood River County, but at the project site the rocks appear to be Troutdale Formation equivalent gravels and sands. These materials are partially cemented, but still appear to be highly erodible under high velocity currents carrying a bouldery gravel bed load.

5.0 HYDROLOGY

The flow data for the West Fork of the Hood River has been gathered from the U.S.G.S. gaging stations at Dee and at Green Point Creek. Green Point Creek empties into the West Fork Hood River approximately 1.4 miles north of the site and the Dee gaging station is about 2.3 miles north (downstream) of the site. The Green Point Creek station was only in operation from 1949-1954, so flows at the site after that time must be estimated using the Dee station information minus estimates from the Green Point station.

The estimated flows through this site are as follows:

Average (50 yrs. @Dee; 5 yrs. @Green Point)	448 cfs
Minimum (1949 @Dee; 1951 @Green Point)	81 cfs
*Maximum (1964 @Dee; 1953 @Green Point)	13,300 cfs

*The gaging station washed out in the December 23, 1964 flood so the maximum flow was based on a daily average.

6.0 EROSIONAL MECHANISMS

The site is located in a deep canyon carved through volcanic rock and flow debris. It appears that an ancient river left a bouldery, gravelly sand deposit in the canyon that was subsequently filled with a volcanic ash flow carrying boulders and gravels. As the flow entered the river channel, it was probably cooled immediately, forming a canyon fill of cemented, bouldery ash. As the river again began eroding a new channel, the process was slowed by the cemented ash. Once the river penetrated the base of the ash, the old stream bed composed of the gravelly sand was exposed, and being more susceptible to erosion, these materials were swept more rapidly downstream than the cemented ash.

As the stream deposits erode, the cemented ash tends to stay in-place until it is sufficiently undercut, then it fails by peeling off in near-vertical slabs. The result at this point is a waterfall about 10 feet in height. As the erosional processes continue, the falls will move upstream, increasing in height while the downstream side continues to erode, maintaining a relatively flat gradient.

The erosion to date has proceeded quite rapidly because of another factor. The channel upstream from the falls is relatively broad and flat while the downstream channel is narrow and confined; thus during periods of high flow the velocity is approximately doubled as water enters the constricted channel. The higher energy downstream has increased the erosional rate, slowing deposition, while the upstream erosion is still proceeding rather slowly.

If you have any questions or desire further information, please contact the undersigned.

Respectfully submitted,
RITTENHOUSE-ZEMAN & ASSOCIATES

CERTIFIED
OREGON
RICHARD W RINNE
#E017
ENGINEERING GEOLOGIST

Richard W. Rinne, C.E.G.

REGISTERED PROFESSIONAL
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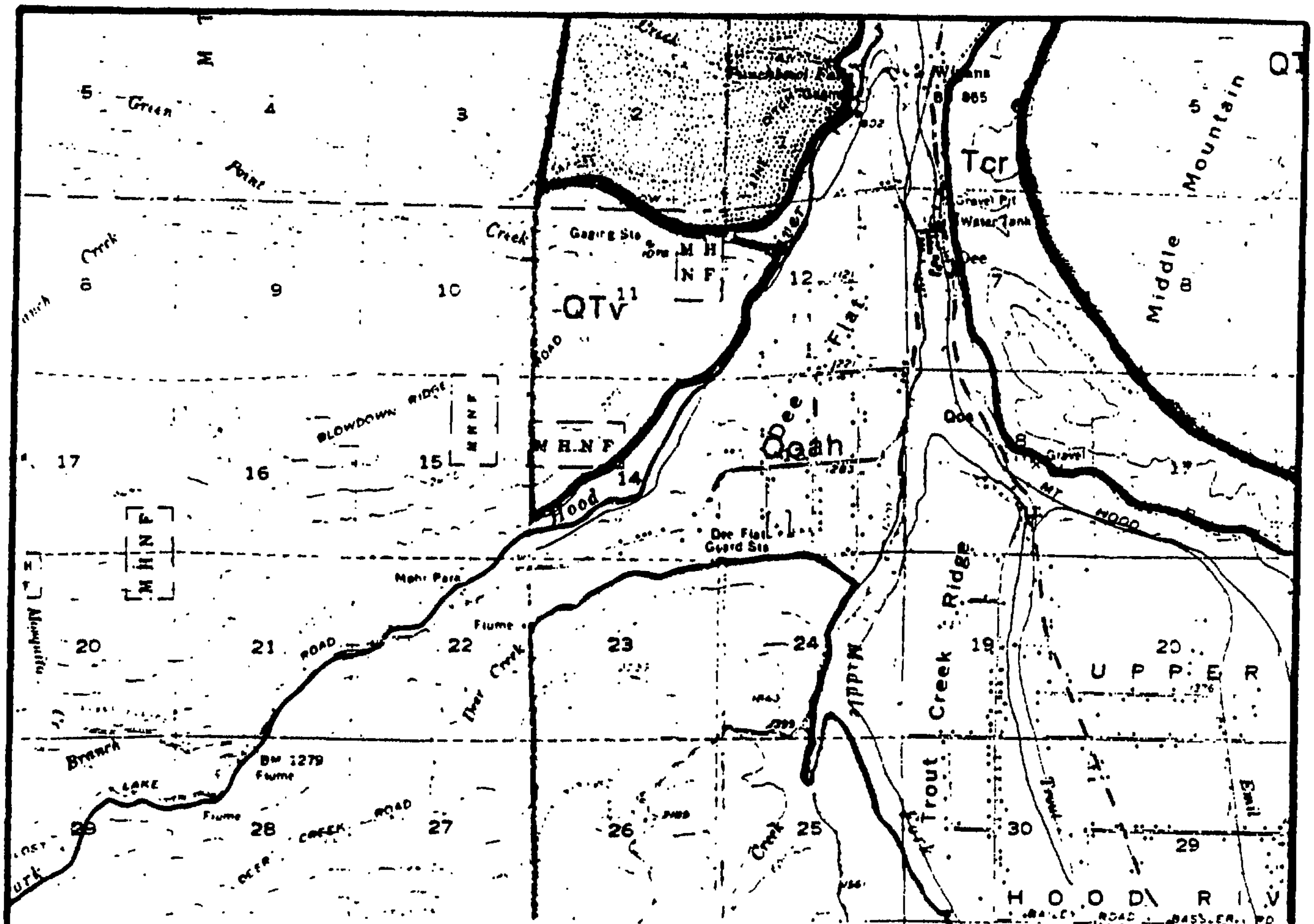
JULY 30, 1976
TERENCE CRAVEN

Terry N. Craven, P.E.

dl



Qoa — **Quaternary older alluvium:** *Unconsolidated gravel, sand, silt, and clay located above floodplains of major streams and as valley fill of smaller stream valleys, equivalent to Qoa and part of Qya of Newcomb (1969), includes several terrace levels of varying ages; generally not subject to flooding except in smaller drainages where scale precludes separate mapping of Qal.*

Qoah — **Quaternary older alluvium of Hood River Valley:** *Unconsolidated glacial outwash and minor interbedded lacustrine deposits and debris flows filling Hood River Valley; includes basal conglomerate and fluvial sand at Hood River.*

High Cascades volcanic rock:

QTv, Qvw 2, Qvw 1, Qvu, Qvp — **Cascades Formation:** *Basaltic and andesitic flow rock agglomerate, tuff breccia, and debris flows of High Cascades volcanic peaks, includes relatively young vents and intracanyon flows in Mount Defiance area and Hood River Valley (Qba), Wind River (Qvw1, Qvw2), Underwood (Qvu), and Parkdale (Qvp) areas, also includes debris flows in Hood River Valley (Qdf) and intracanyon flows (now ridge crests) south and east of The Dalles (QTv); engineering properties and hazards variable. An older Qba unit (Qba1) and a younger unit (Qba2) are mapped near Odell*

Miocene flood basalts:

Tcr — **Columbia River Basalt:** *Extensive flows of dense, dark-gray basaltic lava of upper and middle Yakima Basalt; pillowed lavas, tuffs, and thin interbeds locally, average flow thickness 80 feet, extensive scabland topography at lower elevations; deep, fault-controlled bedrock failures on steep valley sides*

Bedrock Geology modified after Waters, 1973 and Sceva, 1966 by J. D. Beaulieu, 1977
Surficial Geology by J. D. Beaulieu, 1977

N

SCALE: 1"=1 MI.

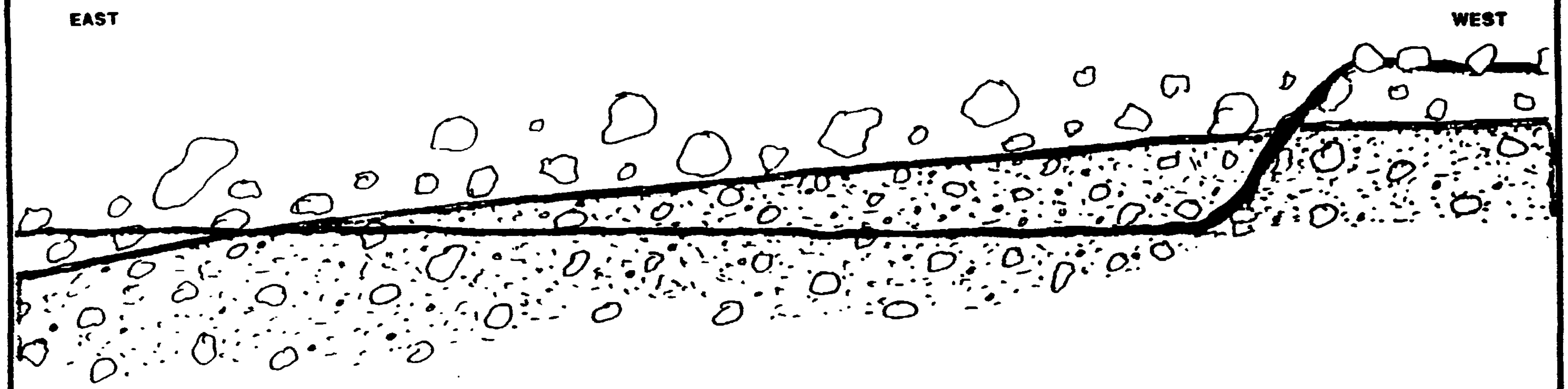
0.5 0 1 2

REGIONAL GEOLOGY

RITTENHOUSE - ZEMAN & ASSOC
FOUNDATION AND SOILS ENGINEERING, GEOLOGY

NOV. 1983	W-2830	RWR

PLATE 1



SECTION THROUGH FALLS

LOOKING SOUTH OCT.1983

DEBRIS FLOW DEPOSITS

TROUTDALE FM.? SANDS AND GRAVELS

WATER SURFACE OCT 1983

NO SCALE

NOV. 1983

W–2830

RITTENHOUSE - ZEMAN & ASSOC
FOUNDATION AND SOILS ENGINEERING, GEOLOGY

PLATE 2

OVERALL VIEW OF FALLS

Note Undercutting

LARGE BOULDERS ABOVE FALLS

VIEW UPSTREAM FROM FALLS SHOWING
BROAD CHANNEL AND FLOOD PLAIN

Note Boulders 4'-6' in Diameter

VIEW DOWNSTREAM FROM FALLS
SHOWING NARROW, CONSTRICTED CHANNEL

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December 1, 1983 0-2830

State of Oregon
Department of Fish & Wildlife
506 S. W. Mill Street
P. O. Box 3503
Portland, Oregon 97208

Attn: Folkert Menger

Subject: Feasibility Study
Hood River Falls Stabilization/Phase II
Hood River County, Oregon

Gentlemen:

In accordance with our contract dated October 4, 1983 we are submitting our Phase II report on the subject project.

1.0 PURPOSE AND SCOPE

The purpose of this study is to identify the erosional mechanisms that have created the falls and submit alternatives and estimated costs for stabilizing them. The State will be responsible for fish passage and that item is not discussed herein.

Phase I of our study consisted of identifying the mechanism of the falls regression. Our Phase I report was submitted to you on November 9, 1983. Phase II of our study, summarized herein, consists of a catalog of eight design solutions. In reaching this list, we have considered over 20 designs, many rejected for reasons cited in this report. Of course, a number of variations are possible on each of the eight general solutions cataloged.

Phase III of our study will consist of a more detailed look at two or three of the most desirable solutions. At the present time it appears that the gabion check dam (Section 3.1), the drilled pier cofferdam (Section 3.5), and the vertical cut-off wall (Section 3.7) would be the most practical and cost effective. We will focus our Phase III report on these solutions unless there are alternate choices that you wish us to consider.

2.0 DISCUSSION OF DESIGN CONSIDERATIONS

The Phase I study indicated that principal erosion is occurring in a layer of partially cemented sand and gravel. This layer underlies the entire falls area and extends laterally to considerable distances both upstream and downstream. All design solutions focus on the protection of this layer by an erosion resistant cap, by a reduction in stream velocity, or some combination of the two.

In addition, we have considered only solutions that maintain the current stream configuration. Any significant modifications of river flow are likely to result in new and unpredictable points of attack. Additional considerations have included:

- anticipate a bedload containing rounded boulders up to six or eight feet in diameter.
- avoidance of designs that would result in major debris hang-up (this can result in channelization of water and erosion of banks).
- protection of banks from scour around any proposed structure; it would not be desirable to substitute horizontal degradation for vertical degradation.

Many of the proposed solutions will require stream diversion during construction. During summer months, when stream flow is low, it would be relatively simple to confine stream flow to one-half of the channel. For the purposes of this report we have assumed summertime construction.

Historically, the most common solution to stream degradation has been the use of sills or drop structures, with bank control measures as required. Because of their proven effectiveness we have concentrated on solutions of this type, although other design measures have also been considered.

In our catalog of solutions we have included only those designs that appear practical. Solutions that were rejected are not discussed. However we do make note of two solutions that originally held promise, but were subsequently rejected. The first of these is pressure grouting of the sands and gravels. Due to the partially cemented character of those materials, our grouting consultant will not offer a sufficient guarantee of success to warrant recommending this solution. Grout penetration may be erratic. We have also eliminated from consideration the use of driven piles or conventionally augered piers. The cementation and occasional boulders make these solutions uncertain. Piers drilled by air-rotary or down the hole hammer methods do appear practical.

3.0 DESIGN SOLUTIONS

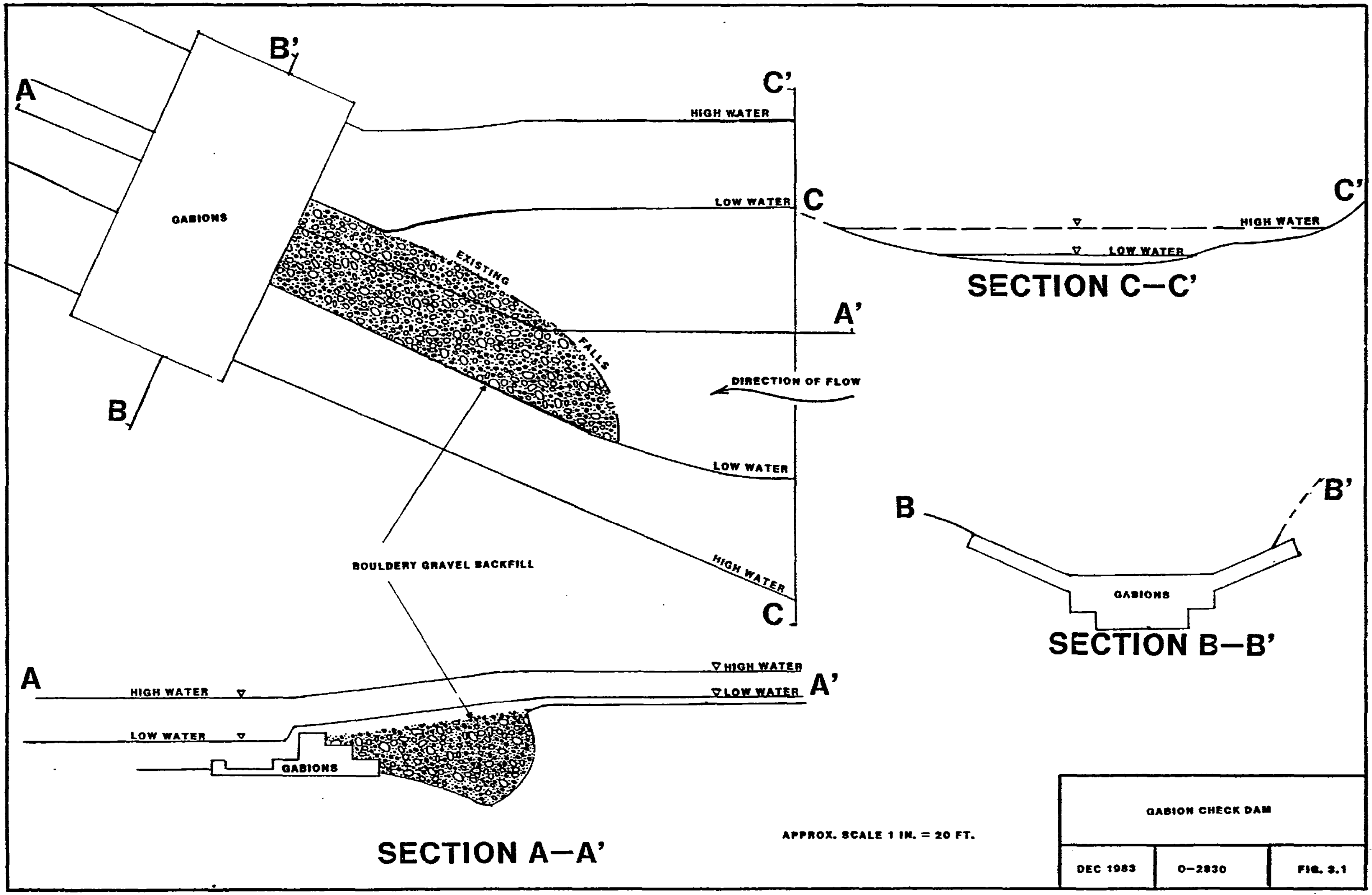
The following solutions appear to us to be practical for erosion control. At this time we have not extensively studied any of these solutions. This Phase II study is intended to provide only rough estimates of cost and quality. More extensive analyses will be performed for our Phase III study. Life expectancies represent an opinion as to the minimum length of time until major maintenance or rehabilitation is required.

Low maintenance structures anticipate little or no repairs necessary during the design life. Moderate maintenance structures anticipate yearly inspections with occasional repairs necessary following severe storms. High maintenance structures anticipate the need for significant annual repairs.

3.1 Gabion Check Dam

Gabions consist of wire mesh baskets, backfilled with native gravels. They are extremely flexible and have the unique ability to absorb a great deal of energy without failure. In an area such as this, where boulder impact is possible, they are usually capped with a layer of heavily reinforced concrete. One possible gabion configuration is shown on Figure 3.1. This figure illustrates a secondary gabion wier and stilling pool below the main dam to prevent scour at the toe. Boulder impact may cause some damage and occasional maintenance of gabions should be anticipated.

Estimated Cost: $100,000
Estimated Life: 10 years
Maintenance: Moderate



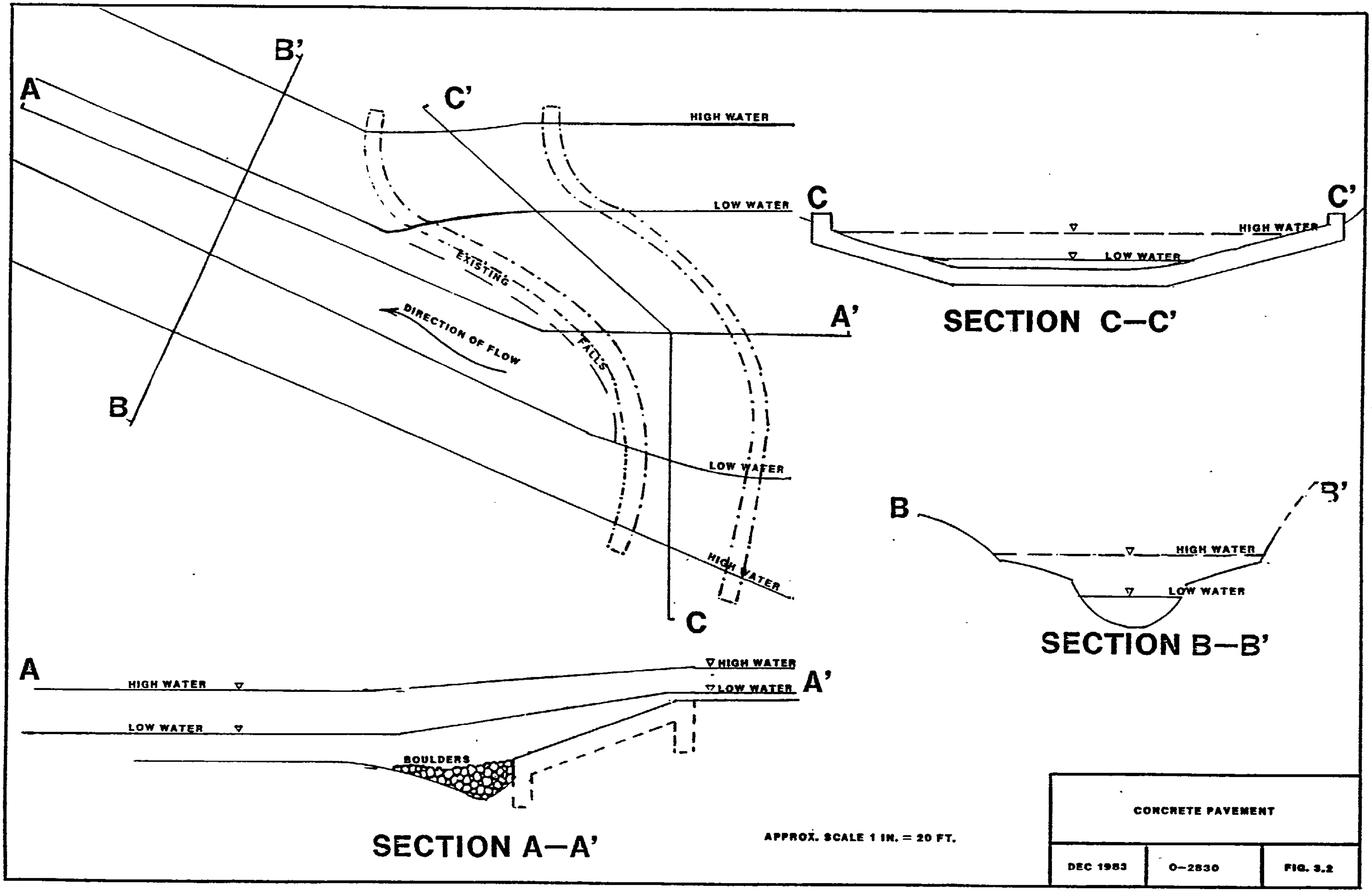
A
B'
B
C'
C
A'
GABIONS
HIGH WATER
LOW WATER
EXISTING FALLS
DIRECTION OF FLOW
LOW WATER
HIGH WATER
C
BOULDERY GRAVEL BACKFILL
C
C'
HIGH WATER
LOW WATER
SECTION C—C'
B
B'
GABIONS
SECTION B—B'
A
A'
HIGH WATER
LOW WATER
HIGH WATER
LOW WATER
GABIONS
SECTION A—A'
APPROX. SCALE 1 IN. = 20 FT.
GABION CHECK DAM
DEC 1983
O—2830
FIG. 3.1

3.2 Concrete Pavement

This solution consists of grading the falls to a uniform slope and paving the slope with a layer of reinforced concrete. One possible configuration for this design is shown on Figure 3.2. This solution indicates a bouldery fill at the downslope end to prevent scour. Other possibilities include a paved downstream blanket or a small weir and stilling pool. This sketch shows a curved configuration that approximates the existing falls, a straight configuration (possibly with a dog-leg) is probably a more likely final design.

There are several proprietary slope paving systems that may simplify this construction, including concrete blocks bonded to large reinforcing mats and interconnected fabric sacks that are field filled with concrete. However, these methods are normally limited to bank erosion control and we have not been able to locate a manufacture who would guarantee his system for this application (due to boulder impact).

Estimated Cost: $250,000
Estimated Life: 40 years
Maintenance: Low



A
A'
B
B'
C
C'
HIGH WATER
LOW WATER
EXISTING
FALLS
DIRECTION OF FLOW
SECTION C—C'
SECTION B—B'
BOULDERS
SECTION A—A'
APPROX. SCALE 1 IN. = 20 FT.
CONCRETE PAVEMENT
DEC 1983
O—2830
FIG. 3.2

3.3 Concrete Wier

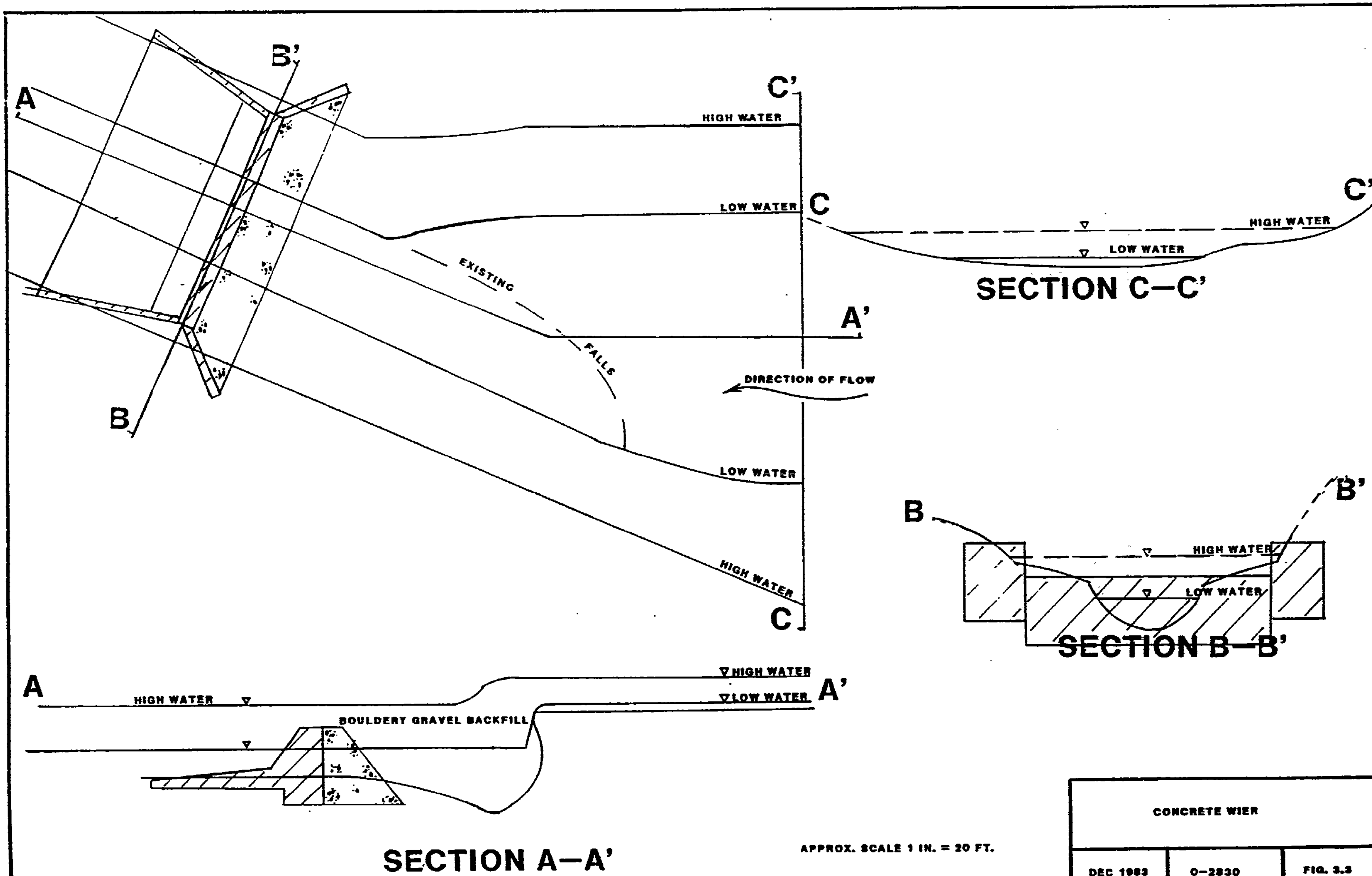
A concrete wier is illustrated on Fiqure 3.3. The design concept is similar to the gabion check dam. This figure illustrates a paved downstream blanket although a wier and stilling pool is also an option. The figure illustrates only a partial backfill (to cushion boulder impact) rather than the full backfill shown with the gabion structure. If the wier is sufficiently high, the upstream pool will back water above the falls, and the existing scour hole will backfill naturally. Alternatively a low wier would require complete backfill as shown on Figure 3.1 (Gabion Check Dam).

Estimated Cost: $200,000
Estimated Life: 40 years
Maintenance: Low

3.4 Cable Net

This solution consists of flattening the slope, blanketing the slope with three foot diameter or larger boulders (native) and restraining the boulders with a cable grid (approximately two feet on center). The grid would be held in place by concrete deadmen or drilled piers. Selected boulders could be anchored to the grid to limit rolling or shifting under the cable, however, we anticipate that occasional maintenance may still be required. This scheme is illustrated on Figure 3.4.

Estimated Cost: $125,000
Estimated Life: 10 years
Maintenance: Moderate



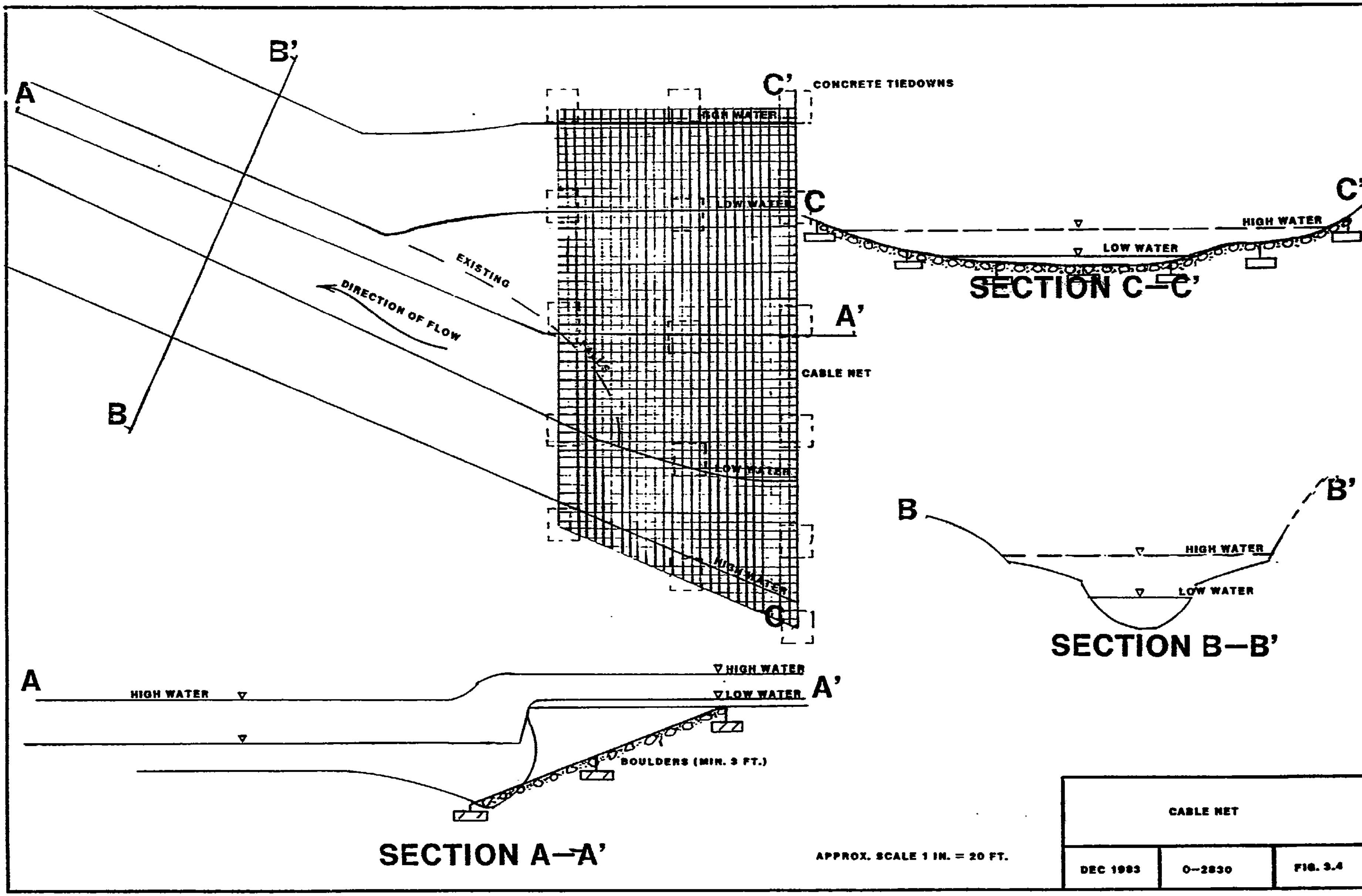
APPROX. SCALE 1 IN. = 20 FT.

CONCRETE WIER		
DEC 1983	O-2830	FIG. 3.3

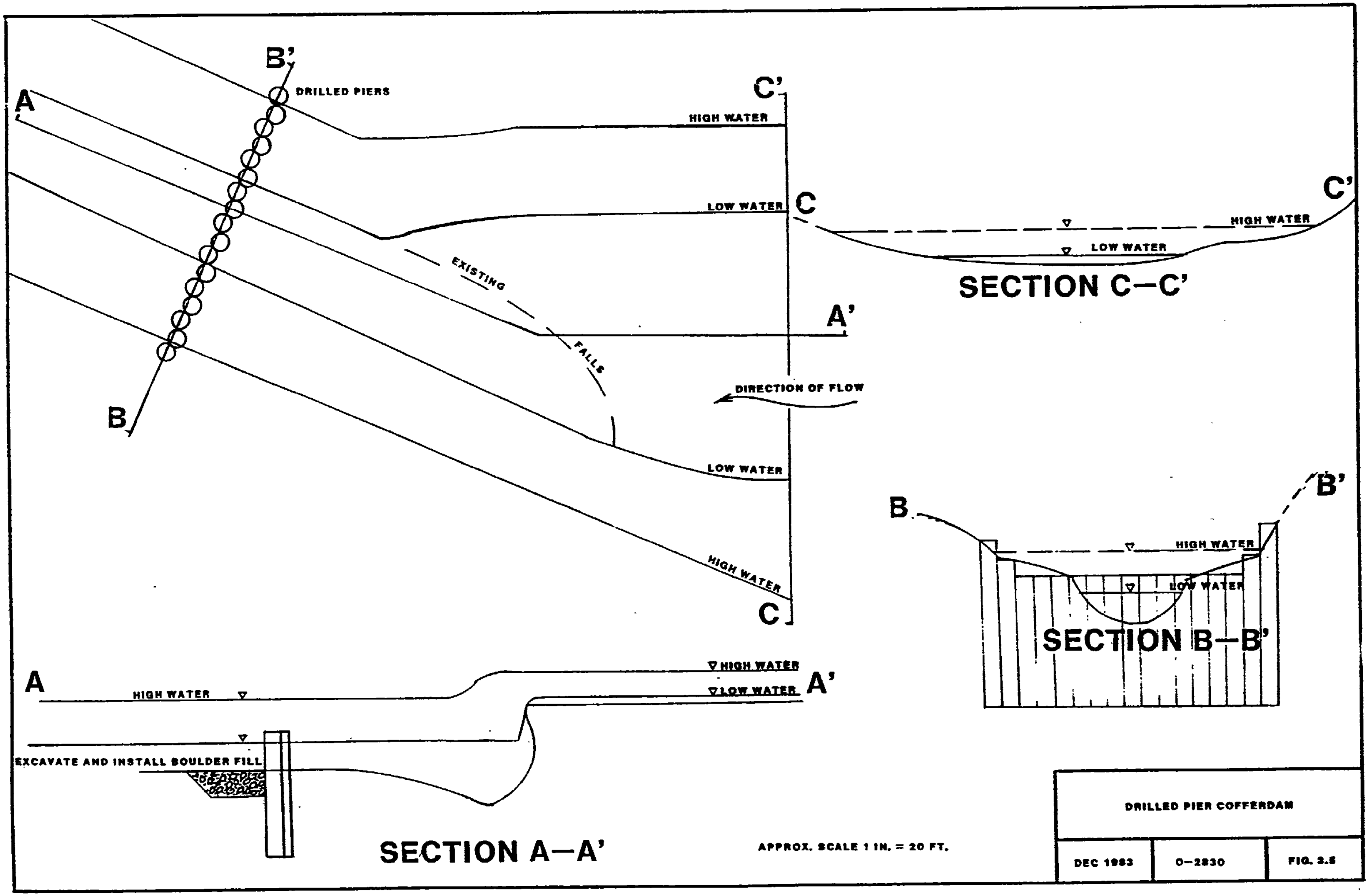
3.5 Drilled Pier Cofferdam

Figure 3.5 illustrates the installation of drilled piers downstream from the waterfall. The piers could be made virtually any diameter (smaller piers may require three or four rows for sufficient strength in bending). Piers would be grouted by tremie methods below the creek bottom and formed above. A boulder or paved downstream blanket is provided to prevent scour at the toe. If the cofferdam is sufficiently high, the upstream pool will back water above the falls, and the existing scour hole will backfill naturally. Alternatively a low cofferdam would require complete backfill as shown on Figure 3.1 (Gabion Check Dam).

Estimated Cost: $125,000
Estimated Life: 40 years
Maintenance: Low



CABLE NET		
DEC 1983	0—2830	FIG. 3.4


B'
DRILLED PIERS
A
C'
HIGH WATER
LOW WATER
C
EXISTING
FALLS
A'
DIRECTION OF FLOW
B
LOW WATER
HIGH WATER
C
C
C'
HIGH WATER
LOW WATER
SECTION C—C'
B
B'
HIGH WATER
LOW WATER
SECTION B—B'
A
HIGH WATER
HIGH WATER
LOW WATER
A'
EXCAVATE AND INSTALL BOULDER FILL
SECTION A—A'
APPROX. SCALE 1 IN. = 20 FT.
DRILLED PIER COFFERDAM
DEC 1983
0—2830
FIG. 3.5

3.7 Vertical Cut-Off Wall

For this scheme a slot is excavated behind the existing falls and a concrete wall is poured in place. To reduce wall thickness and depth, we have included a tie back anchor. Eventually the falls will regress to the wall location and a second phase of construction will be necessary to install toe protection (probably boulder rip-rap) at the downstream face to prevent scour. This design is shown on Figure 3.7.

Estimated Cost: $150,000
Estimated Life: 40 years
Maintenance: Low

3.6 Steel "H" Pile Wall and Lagging

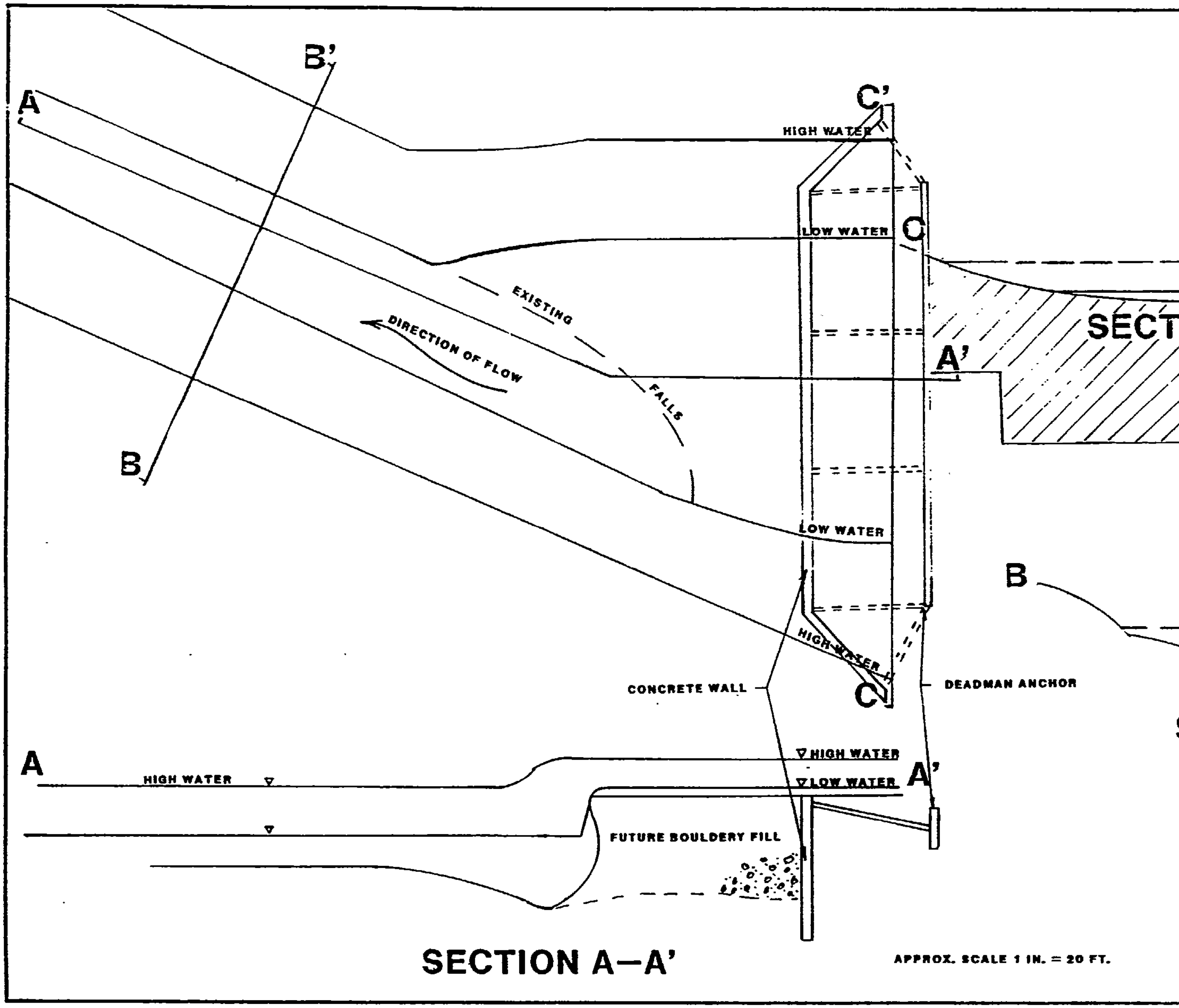
This scheme (not illustrated) would be similar to the drilled pier solution (Section 3.5). Holes would be drilled at a six to 10 foot spacing and heavy steel "H" sections installed and grouted in place. Lagging would span between the "H" sections and backfill placed to absorb impact loading. The principal advantage is that porous lagging could be provided to prevent hydrostatic pressure buildup behind the wall (allowing a thinner section). Because the wall is not continuous (as was the drilled pier solution), greater pier penetration is required for this design.

Estimated Cost: $125,000
Estimated Life: 20 years
Maintenance: Low

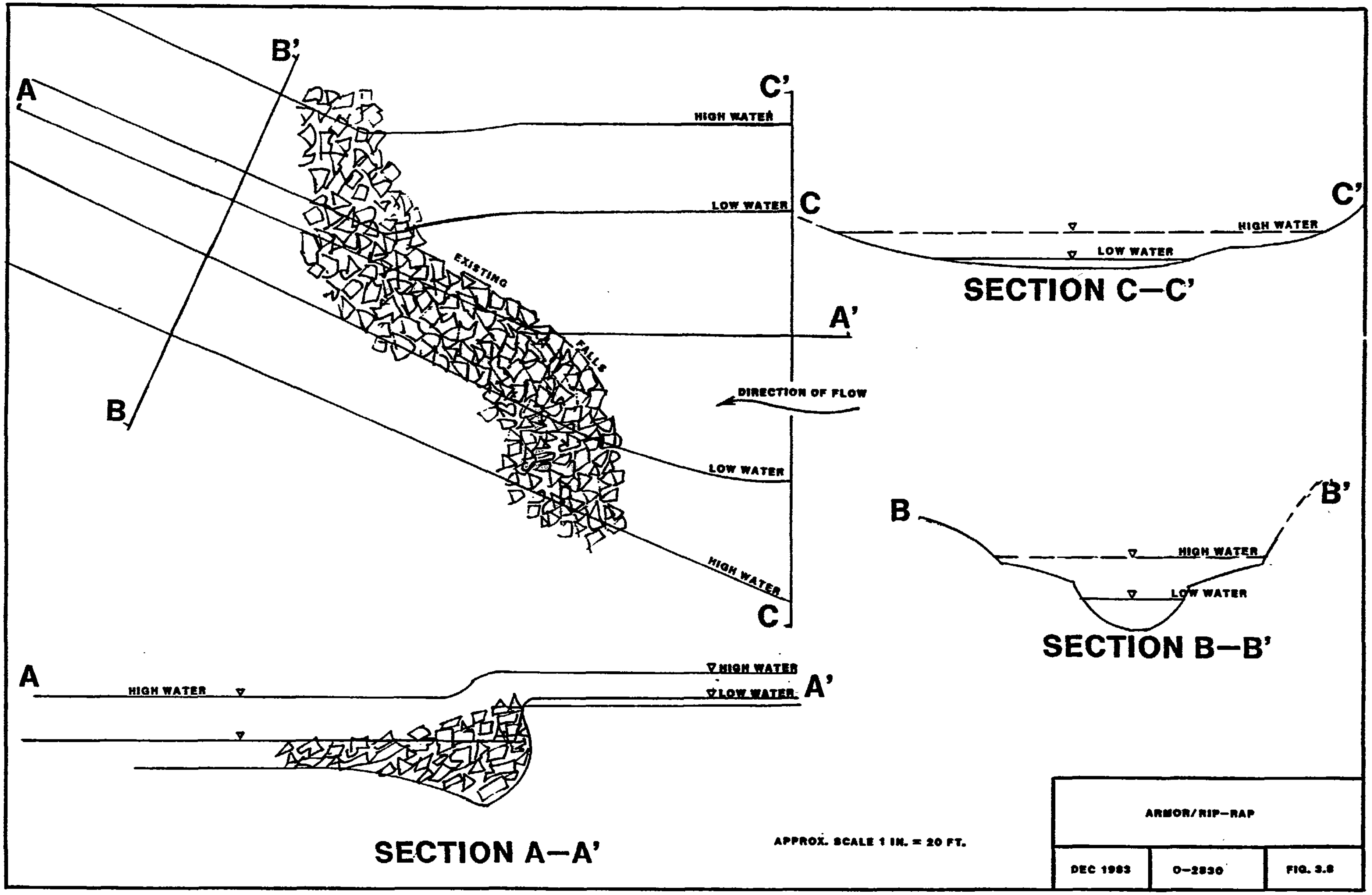
3.8 <u>Armor/Rip-Rap</u>

Heavy armor rock can be provided to resist erosion. This solution is shown schematically in Figure 3.8. Although not subject to rigorous analyses, it is probable that angular basalt quarry rock in the range of seven to eight feet in diameter would be adequate to resist erosion. Alternatively many other waste type materials may be available locally, including crushed automobile bodies, waste concrete blocks, concrete pile cut offs and similar materials. Some of these items could be lashed together with cable to increase stability. The principal disadvantage of this type of solution is that it can lead to debris hang-up, channelization of water and somewhat unpredictable points of new erosion. Undercutting of banks would be a major concern and maintenance will certainly be required, but this design could potentially be very economical.

Estimated Cost: $40,000 - $60,000
Estimated Life: 5 years
Maintenance: High



VERTICAL CUT-OFF WALL		
DEC 1983	0-2830	FIG. 3.7



ARMOR/RIP-RAP		
DEC 1983	O-2830	FIG. 3.8

If you have any questions or desire further information, please contact the undersigned.

Respectfully submitted,
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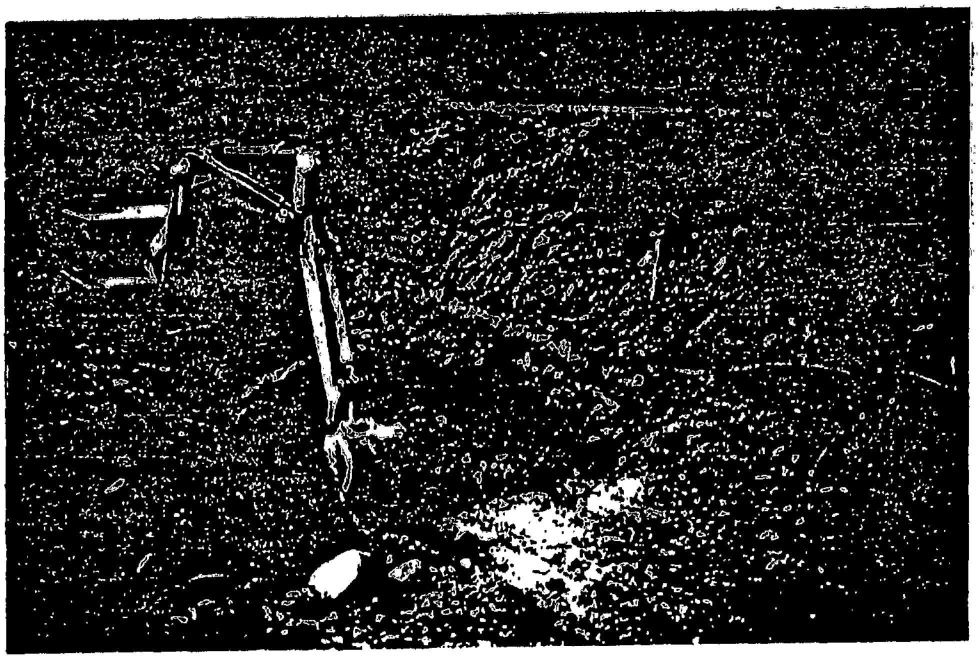


Beginning construction of a rock
weir in Side Channel 17.

Upstream veiw of a completed rock
weir prior to opening channel.

Typical finished rock weir.

Figure 10 - Rearing pool construction.

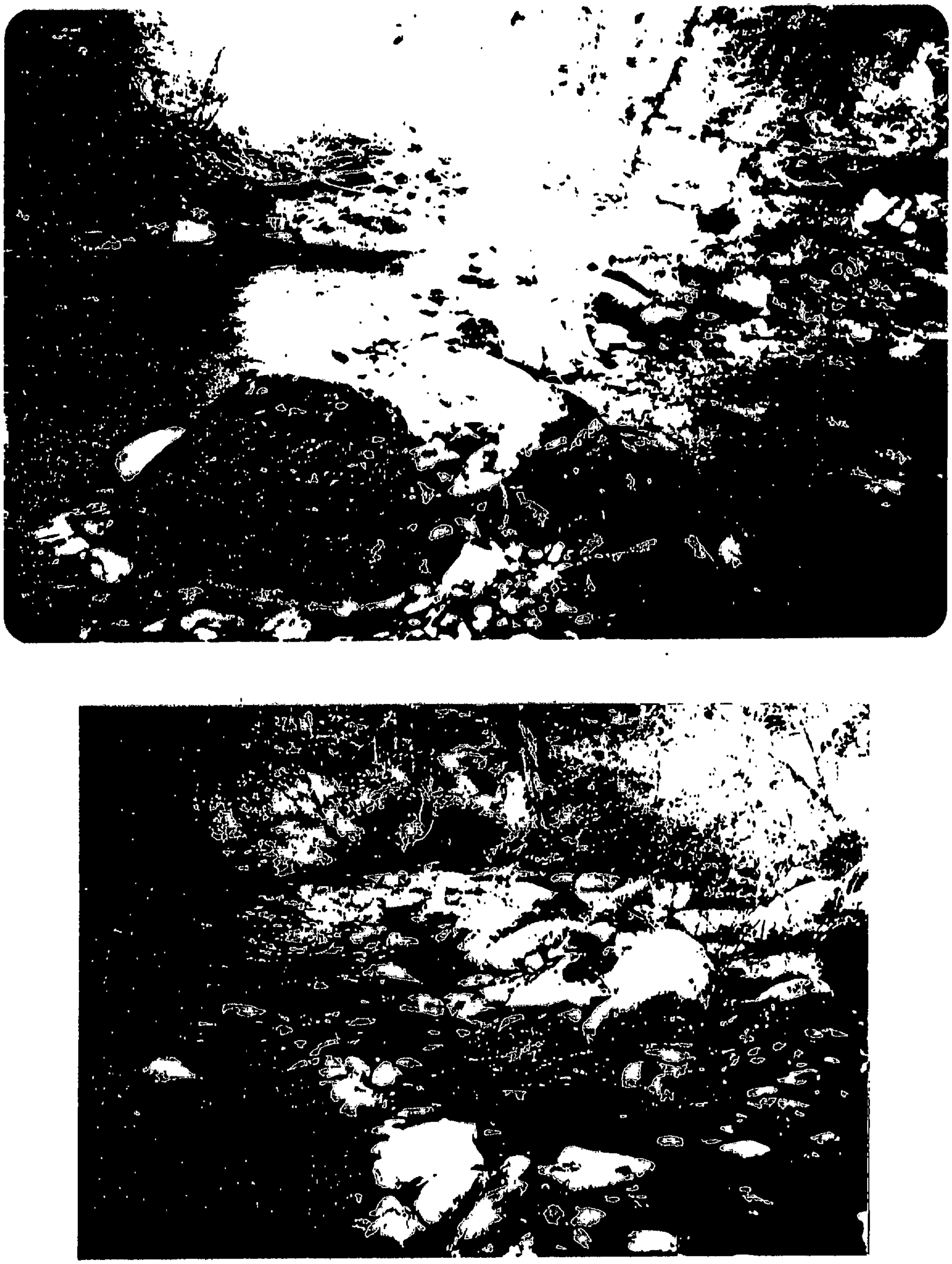


Figure 11 - Rearing pools, mid channel berm.

Figure 12 - Rearing pools, looking downstream.

Figure 13 - Log jam, prior to partial removal.

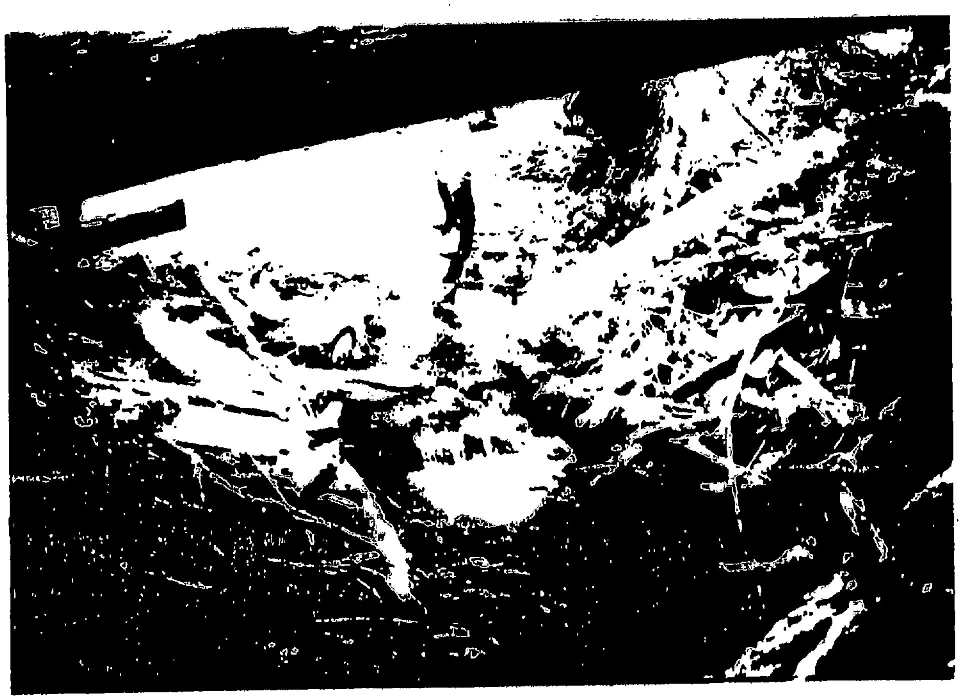


Figure 14 - Passage openings cut through log jam.

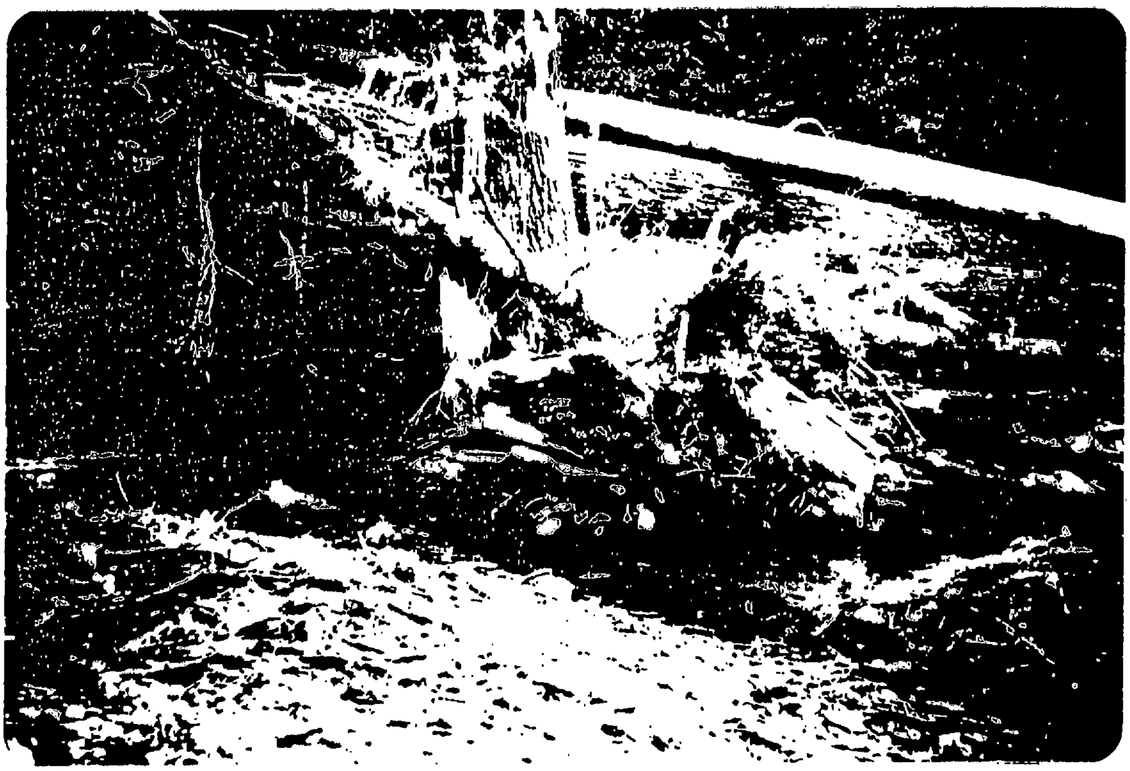
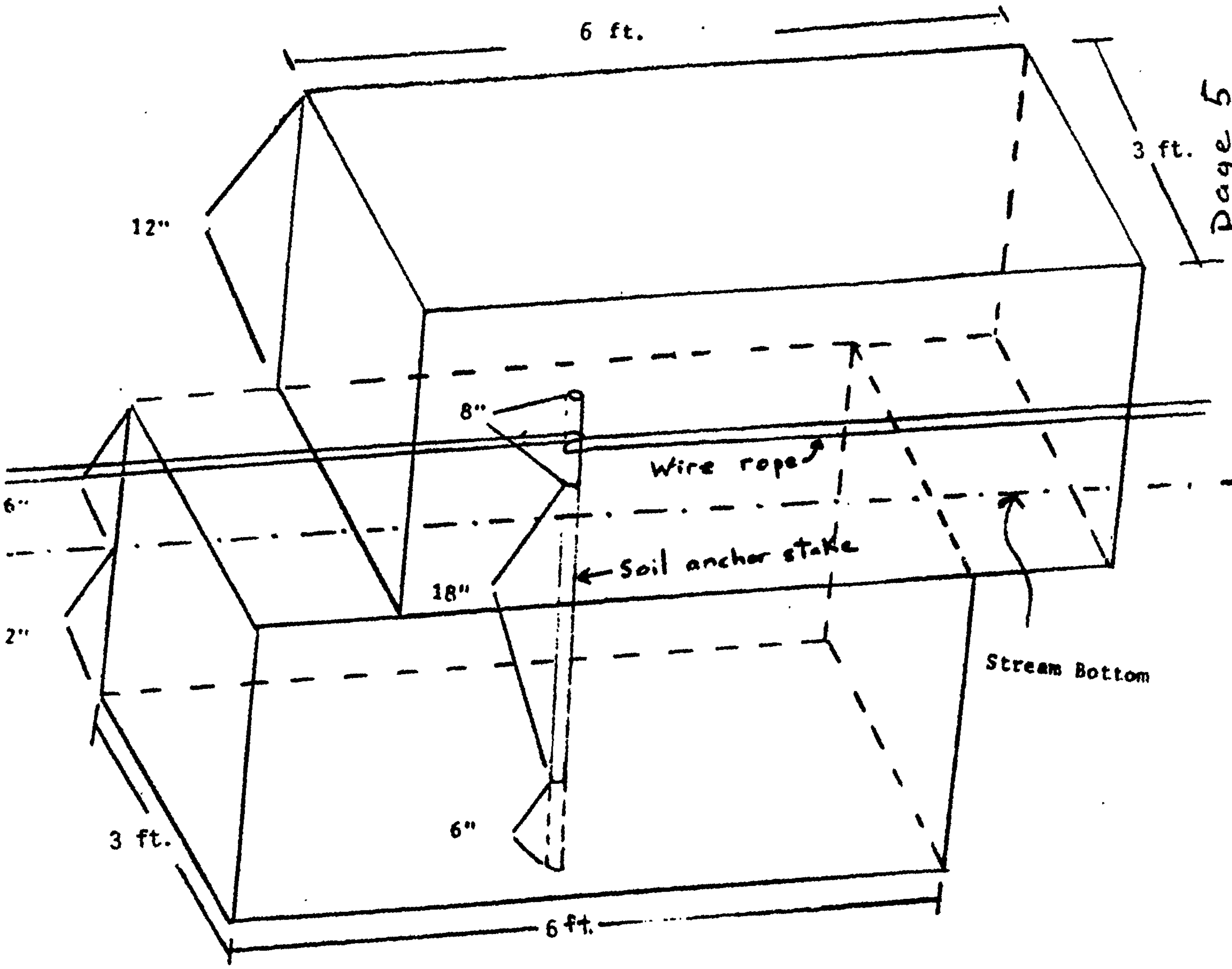


Figure 15 - Log jam partial removal.



Page 5

GENERAL DESCRIPTION - GABION SECTION

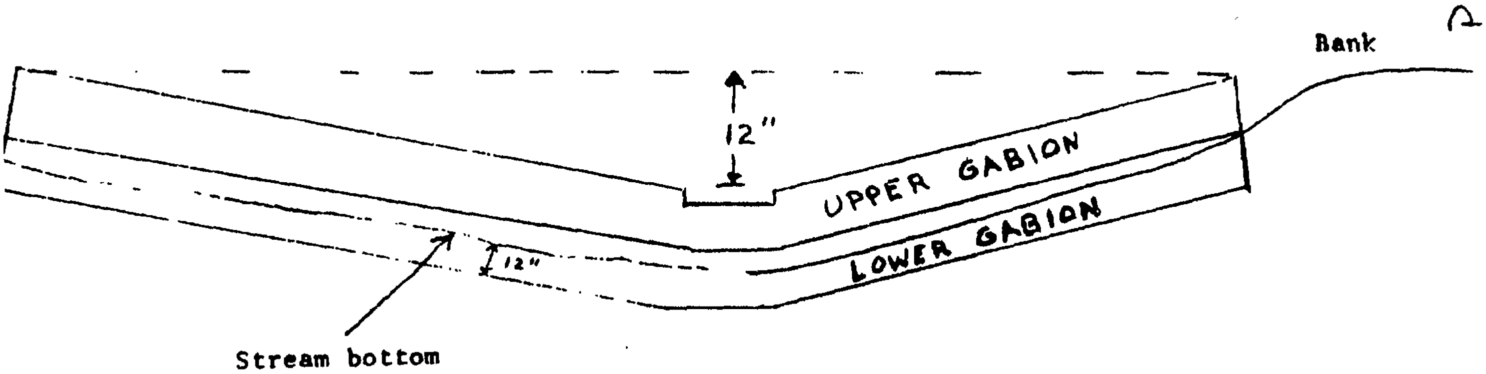
Not to Scale

Figure 16a

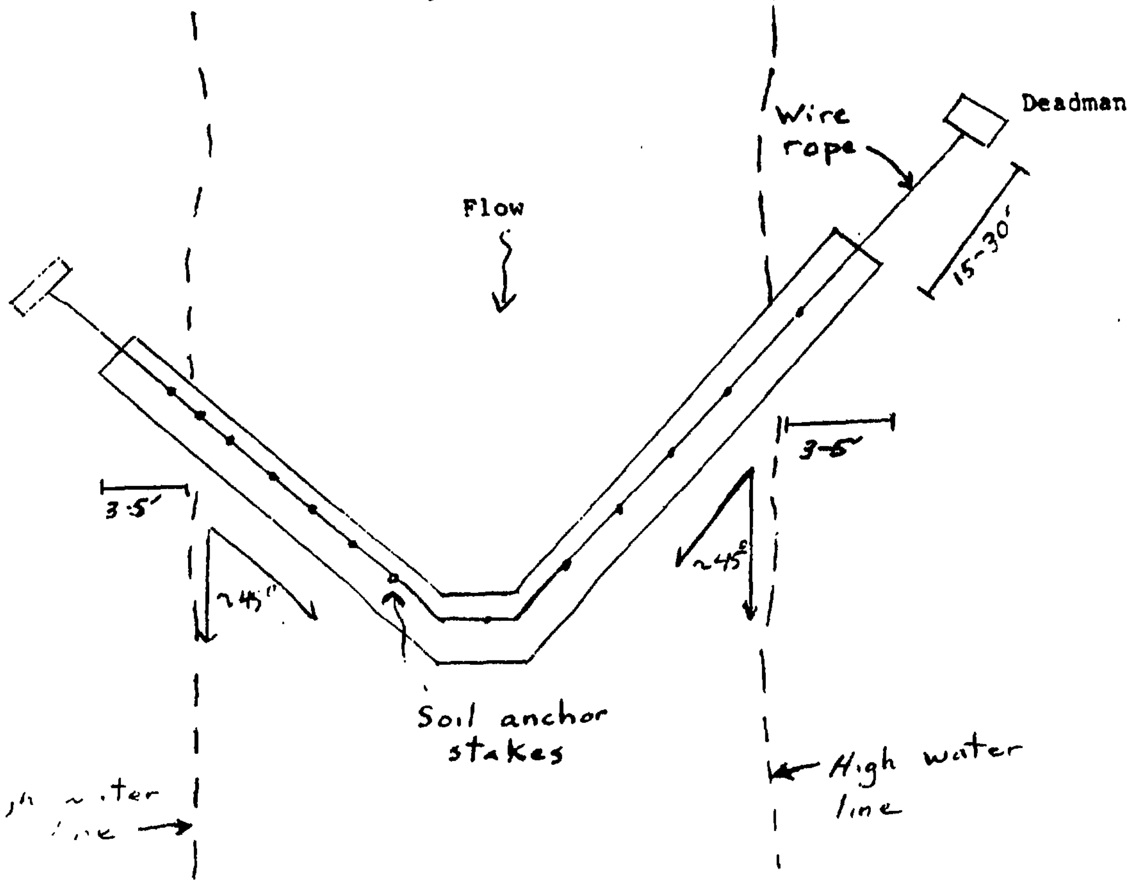
Figure 16b

Gabions

Up Stream View



Plan View



Not to Scale

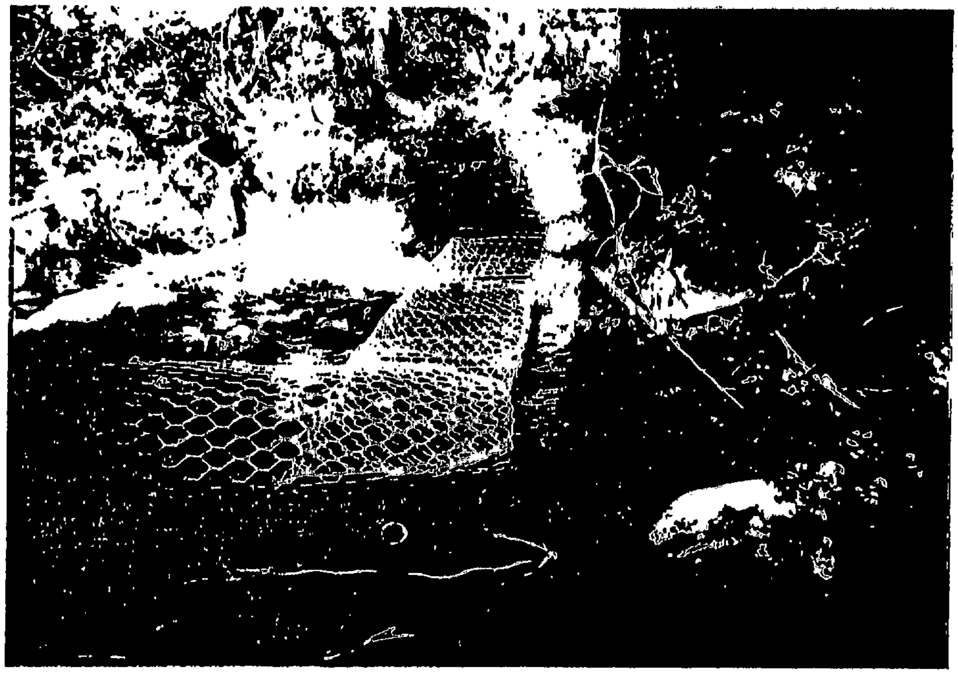


Figure 17 - Bottom layer of baskets with soil anchor stakes.

Figure 18 - Hand filling gabion baskets.

Figure 19 - Gabion construction.

Figure 20 - Upper gabion complete.

TROUT CREEK RIPARIAN HABITAT RESTORATION: PHASE I

ANNUAL REPORT, 1983

By

Scott English
Northwest Biological Consultants
Ashland, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP14228
Project No. 83-423
Project Officer: Dale Johnson

ABSTRACT

This quarterly report reviews the tasks performed for Phase 1 of the Trout Creek Riparian Restoration Project. Tasks 1.1 through 1.6 were done as described in the project proposal. Northwest Biological Consulting has established contact with the pertinent resource and land management agencies. Project coordination was acomplished by meetings with agencies and landowners. Aerial photo interpretation and mapping was integrated for fisheries, wildlife, botany, and geomorphology. Inventory methodologies were developed for the fisheries and botany disciplines. Finally, hydrological data was evaluated and pertinent information was produced for the watershed.

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INTRODUCTION

In September 1983, the Bonneville Power Administration contracted Northwest Biological Consulting (NBC) to develop and inventory and watershed restoration plan for the Trout Creek basin in Central Oregon. The restoration effort was designed to be comprehensive, and includes direct participation by the Oregon Department of Fish and Wildlife (ODFW), the Soil Conservation Service (SCS), and the Jefferson County Soil and Water Conservation District (SWCD). ODFW has provided technical input, while SCS and SWCD project responsibilities have focused on landowner liason and coordination with other agencies.

The project is designed to provide an integrative overview of the Trout Creek watershed, analyze key factors affecting anadromous fish production, and then develop a comprehensive plan to restore anadromous fish runs in the drainage. The project is an outgrowth of the Northwest Power Planning Council's Fish and Wildlife Program, which makes off-site mitigation of anadromous fish losses due to dam building a priority among Federal and State power-producing agencies.

The riparian habitat restoration program is being conducted in two phases. Phase 1 is a basin overview and air photo analysis of Trout Creek and its major tributaries, and development of field methodology. Phase 2 is a comprehensive field study and analysis, and development of a restoration plan for the drainage. This is the final report for Phase 1.

The contract for Phase 1 identified a number of specific tasks to be completed in order to meet contract requirements. We would like to list these tasks, and briefly describe what we have done for each.

Task 1.1 Agency Contact and Coordination. NBC staff have met with agency personnel from the Oregon Department of Fish and Wildlife, the Soil Conservation Service, the U.S. Forest Service, the Bureau of Land Management, and the Oregon Department of Public

Works (Watermaster), as well as members of the Jefferson County Soil and Water Conservation District Board, staff members of the Oregon Natural Heritage Program, and specialists at the University of California and elsewhere. Appendix A gives a list of contacts made during Phase 1, and the dates on which they were contacted.

Task 1.2 Onsite Project Coordination. Several coordination meetings were held with SCS, NBC, ODFW, the SWCD, and Trout Creek basin landowners, and minutes of these meetings were taken and summarized. Recently, the meeting format has been changed, and the coordination meetings are now included in the monthly SWCD Board meetings.

NBC staff have met with approximately 25 landowners in the Trout Creek basin. The general scope of the project and the inventory techniques being used were presented, and comments were invited regarding stream survey procedures. In some cases the ranchers observed the field crews taking measurements.

Task 1.3 Aerial Photography. Aerial photographs were obtained for the Trout Creek and its major tributaries (Ward Creek, Ten Mile Creek, Antelope Creek, Little Trout Creek, Big Whetstone Creek, Hay Creek, Wilson Creek, Little Willow Creek, Amity Creek, and all tributaries of Trout Creek in the Ochoco National Forest). Vertical color photographs were taken at a scale of 1:3,000 using a 70 mm camera. 219 photos were available from ODFW; an additional 1200 were taken as part of this contract in order to complete coverage of Trout Creek and tributaries. A flight index map of the photos taken for this project is included as Appendix B.

Task 1.4 Riparian Habitat Photographic Evaluation. This step involved analysis of the air photos and other information and mapping significant fisheries, wildlife, vegetative, geomorphic, and other features for Trout Creek and its major tributaries. Each specialist mapped key features for his discipline on a clear acetate overlay of a 1:24,000 USGS topographic map of the area (for more information on how this was done, please refer to the following sections of this report). These maps were later compiled into composite overlays for 18 stream reaches within the drainage. Appendix C is the result of this effort, and displays fisheries, geomorphic, vegetation and wildlife information on mylar overlays of topographic base maps.

Task 1.5 Field Evaluation Methodology and Testing Inventory Techniques. Field verification of elements mapped from aerial photographs was undertaken by the specialist for each discipline. In addition, field inventory methodologies were developed for fisheries and riparian vegetation assessment work. The fisheries and vegetation sections which follow explain how these methods were selected, refined and field tested.

Task 1.6 Hydrology. The project hydrology specialist, ~~Dennis Harr, has~~ evaluated the historical flow and precipitation data for the Trout Creek watershed. ~~He has~~ also produced watershed profiles, cross sections, flow exceedence curves, and other pertinent information which will be used in the engineering design and stream rehabilitation prescriptions. (refer to the hydrology section for more details)

The following sections of this report explain in detail how each resource was analyzed in Phase 1 and the results of this analysis. They also take an integrated look at the Trout Creek basin, correlating the results of each assessment with those of other resources. We urge you to read these sections for more detailed information on the points listed above and for a more detailed assessment of the watershed.

OVERVIEW OF THE TROUT CREEK WATERSHED

Trout Creek is a major tributary of the lower Deschutes River in Central Oregon. The creek rises in the Ochoco Mountains, and flows fifty miles northwest before emptying into the Deschutes 68 miles north of the city of Bend (Figure 1).

The Trout Creek watershed covers roughly 750 square miles (480,000 acres) of land in Jefferson and Wasco Counties. Agriculture is the predominant land use; the western third of the watershed is predominantly cropland, with mint, potatoes, wheat and alfalfa being major crops. The eastern two-thirds of the drainage is used for livestock grazing, with cropland (alfalfa, sweet clover, hay) in the valley bottoms. Commercial logging occurs in the southeastern part of the watershed, and there are several mines in the drainage.

There are 132 separate landowners in the drainage. Approximately 23,000 acres of the Trout Creek watershed are within the Ochoco National Forest; almost all the remainder is privately owned. The Haycreek Ranch (45,000 acres), Diamond International (36,000 acres), and the McDonald Ranch (23,000 acres) are the large blocks of land in the basin. Most other blocks of private land are smaller, averaging from 320 to 6,500 acres. Appendix D shows land ownership and lists landowners in the Trout Creek Basin.

The Trout Creek watershed is located largely within the High Lava Plains and Columbia Plateau physiographic province, with the southeastern third of the drainage lying in the Ochoco, Blue and Wallowa Mountains province. Elevation ranges from 1380 to 5940 feet above sea level. Climate in the watersheds is characterized by hot summers and cold winters, with recorded temperatures ranging from -28 to 100 F. Precipitation varies from less than 10 inches annually on the western edge of the watershed to over 25 inches in the Ochoco Mountains. At lower elevations most precipitation falls as rain, while most falls as snow in the mountains. The bulk of the watershed's precipitation falls from October through March, although summer thunderstorms can also drop substantial amounts of moisture.

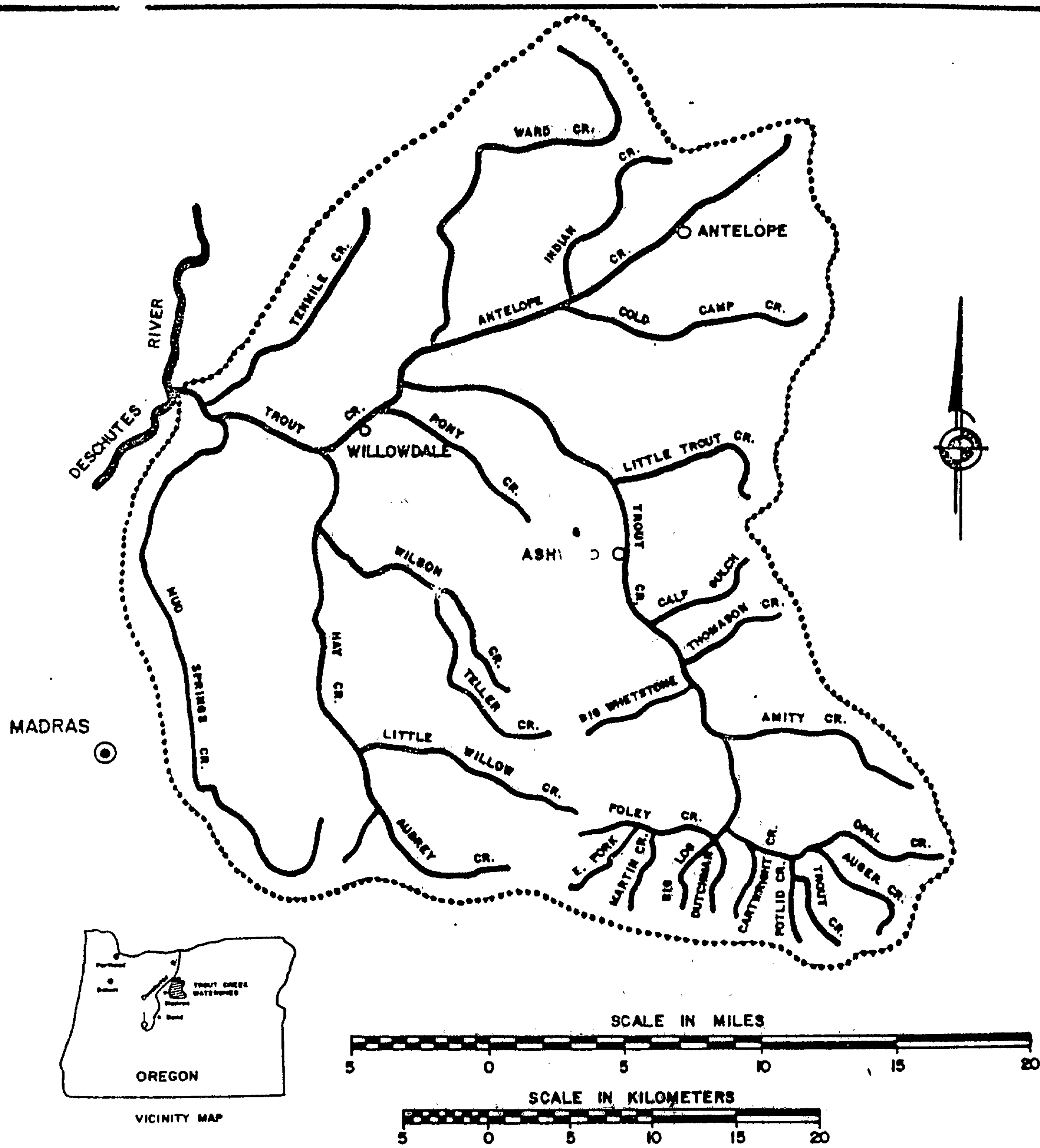


Figure 1. LOCATION MAP

TROUT CREEK WATERSHED

The Trout Creek watershed is underlain predominantly by volcanic bedrock of recent origin. Small portions of the watershed are composed of shale and sandstone of Mesozoic origin; the rest is underlain by basalt, ash, and other volcanic material laid down within the last 55 million years.

Soils in the Trout Creek area are derived from several sources, including weathered bedrock, ash and pumice from geologically recent volcanic eruptions, alluvium deposited at the base of mountains or cliffs or washed down in streams, and wind-deposited loess. Slope and aspect have had a significant influence on soil formation and vegetation, particularly in sheltered areas where volcanic ash deposits have remained to create deep, moist soils.

The hydrology of the Trout Creek basin is typical of semi-arid watersheds that have areas high enough to receive snow. The majority of the streams head in the Ochoco Mountains, which receive the highest precipitation in the drainage (the Ochocos provide 37% of the water yield of Trout Creek, even though they only comprise 17% of the watershed). The upper tributaries of Trout Creek and Hay Creek are perennial streams whose flows are dependent on Ochoco Mountain's snowmelt. Other perennial streams are maintained by springs.

Stream flows in Trout Creek have varied from 25 cubic feet per second (cfs) to 3,000 cfs during the last 15 years. Flows are highest from January through April, with the largest flows occuring in March. August, September and October are the low-flow months, with minimum flows in September. It is not unusual for many tributaries and even parts of Trout Creek itself to flow intermittently during late summer and early fall.

There are three major types of native vegetation in Trout Creek: conifer forest, high desert, and riparian communities. The coniferous forest grades from mixed conifer (Douglas fir-larch-white fir) to Ponderosa pine; the high desert is made up of juniper woodland, sagebrush steppe, canyon, and bunchgrass communities. The riparian communities include willow and alder woodland, meadows, marsh, and open water. Much of the sagebrush steepe and almost all of the bunchgrass have been converted to cropland, as have many meadow areas. Almost all the remainder is grazed by livestock.

More than 300 fish and wildlife species are found in the drainage. Trout Creek supports mule deer, elk, chukar and other game species, golden eagle, prairie falcon and other raptors, and numerous nongame species. Historically, the watershed supported chinook salmon, steelhead and rainbow trout populations. Currently, the basis supports summer steelhead and rainbow trout.

Although the first white explorers came into Trout Creek in the 1820's, it wasn't until the discovery of gold in the John Day Country during the 1860's that white settlers began moving into the basin. The lush meadows and fertile soils of the Trout, Antelope and Hay Creek drainages attracted early stockmen, and ranching operations were established throughout the drainage by the 1870's. Some of the largest cattle and sheep ranches in the Pacific Northwest were developed in the Trout Creek watershed (Soil Conservation Serivce, 1970). The railroad line was built to Shaniko Junction (2 miles north of the Trout Creek-Buckhollow Creek divide) in 1900, and between 1900 and 1911 Shaniko was one of the largest wool-shipping stations in the world.

Starting in the 1880's farming became widely established in the basin. Farming in the Trout Creek watershed got a major boost with the completion of the Deschutes Project in 1946, which assured a reliable water supply for irrigators in many parts of the Trout Creek watershed. Agriculture remains the major occupation in the watershed, with irrigated farmland in the lower elevations and the western side of the drainage, and ranching throughout the remainder.

FISHERIES

Watershed Overview

Trout Creek is a sixth order stream which drains into the Deschutes River at river mile 88.5. It is the largest on the east side of the Deschutes below Pelton Dam, and has significant anadromous fish production potential. This large tributary is therefore highly significant for meeting the Northwest Power Planning Councils's primary goal of restoring natural production of salmon and steelhead in the Columbia River Basin.

The Trout Creek Watershed has been intensively grazed for the last one hundred years and watershed alternations and extensive riparian habitat degradation have severely depleted anadromous fish populations. Historically, the watershed supported chinook salmon and steelhead trout populations. There were also viable populations of rainbow trout. Currently, the basin supports only a run of about 250 adult summer steelhead trout (United States Bureau of Reclamation 1981), and some rainbow trout. The summer steelhead is considered the most valuable fish species in the lower Deschutes River (USBR, 1981). The degraded habitat of Trout Creek has been the primary factor for the declining production of salmonids.

Water and related resource problems are the limiting factors for steelhead production in the Trout Creek watershed. Average annual precipitation ranges from about 10 inches a year along the western edge of the watershed, to approximately 25 inches of the southeastern corner (Ochoco Mountains). All but the upper reaches of Trout Creek, and a few tributaries, frequently have intermittent summer and fall flows. Most of the drainage also has excessive water temperatures which are limiting for salmonid production during the summer months. Additionally, most of Trout Creek is appropriated for irrigation, leaving little or no water for other uses. Finally, there are several unscreened water diversions on the creek which operate during the downstream migration of steelhead juveniles.

There are approximately 140 stream miles in the watershed and about 85% of those miles have riparian problems (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1981). However, there is also potential improvement with rehabilitation efforts for about 120 miles (USFWS and NMFS, 1981). These efforts would probably make Trout Creek one of the highest producers of wild anadromous stocks for the lower Deschutes River. And moreover, since the Deschutes River system supports several of the largest remaining stocks of wild runs of anadromous fish in eastern Oregon, the significance of Trout Creek is further emphasized.

Introduction

The three primary responsibilities of the senior fisheries staff for Phase I of the project have been performed as follows:

1. Agency/Landowner Contact and Coordination. The senior fisheries staff have established contact with the Oregon Department of Fish and Wildlife (ODFW), the U.S. Forest Service (USF), the Soil and Water Conservation District (SWCD), and the Soil Conservation Service (SCS). Contacts for most of the Trout Creek property owners have also been initiated. To date, four agency coordination meetings, and one public meeting have been held to coordinate the projects with the landowners and affected agencies. The fisheries staff have presented their general plans for surveying the watershed and have also invited comments on procedures.

2. Development of Stream Survey Methodology. A fisheries field inventory methodology for the Trout Creek watershed was developed from field forms used by ODFW, USFS, and the Bureau of Land Management. All existing field inventory methodologies which are currently being used for lower Deschutes River tributaries were incorporated. Northwest Biological Consulting (NBC) worked closely with ODFW to develop a survey format which would provide

enough information for the decision making/prescription process. The final field methodology was reviewed against the project objectives by the senior staff biologists for reliability and accuracy.

Methodology

The first task was the development of a field form which accounted for the project objectives. Existing field inventory methodologies and forms used by ODFW and other agencies were adapted and modified as necessary to accomplish this goal.

The basic form utilized was developed by ODFW for stream riparian habitat inventory. Additions to this form include total stream shading, riparian shading, stream channel profile, pool/riffle inventory, spawning inventory, photo record, channel stability evaluation, and special features forms. These additions were necessary to obtain a complete overview of all problem areas, available habitat, and potential for habitat improvement in the basin. The final fisheries form is shown in Figure 1. Apendix E gives a detailed description of the stream survey methodology developed for the project.

Field Testing of Methodology

The inventory methodology was developed in phases, and representative areas in the watershed were field tested. After initial field testing it was decided that rating quality for every pool and riffle would be very time consuming, as surveyors could only cover 3/4 to 1 mile per day. It was felt that a percentage of pools in each section could be rated to represent the pool quality in the entire section. Since riffle quality was observed to change little for a section, only 3 to 5 riffle ratings will be taken. This will enable us to establish overall quality for a section.

The final format developed will include measurements of all pools and quality ratings for up to 16 pools in every section. Surveyors will observe the first few hundred feet of a section to

PHOTO RECORD:

Roll ____ Begin ___ End ___

Number ____ Description of Picture

____ ____

____ ____

____ ____

____ ____

____ ____

____ ____

____ ____

COMMENTS:

LIMITING FACTORS FOR FISH ARE:

STREAM SURVEY FORM

Observer __________ Date __________ Section ______

Stream __________ RM (range)________ T ___ R ___ S ___

Precip Today ___ Yesterday ___ This Week ___

Section Summary

Temperature (^{o}F) Air ___ Water ___ Time ___

Stream Flow (CFS) _____ Section Length _______'

Average Channel Width ___' Range of Width(ft)_______-_______

Average Pool Depth ___' Range of Pool Depth(ft)_______-_______

Pool Quality(%) Good ___ Fair ___ Poor ___

Riffle Quality(%) Good ___ Fair ___ Poor ___

Total Pool Area (YDS^2) _______ Pool/Riffle Ratio _____

Turbidity (clear, murky, muddy) Gradient(%)______

Stream Shading(%) _____ Riparian Shading(%) _____

Riparian Ground Cover(%) ___Left Bank ___Right Bank

Riparian Cover Composition(%-Left) ___ Grass ___ Shrub ___ Tree

Riparian Cover Composition(%-Right)___Grass___Shrub___Tree

Riparian Grazing Activity ___None___Light___Mod___Heavy

Upland Ground Cover ___Poor ___Fair ___Good ___Excellent

Spawning Gravel (YDS^2) ___Total ___Good ___Fair ___Poor

Gravel Classification Rationale ____________________

Fish Species	Size/Class (YOY,1+,Res)	0-5	6-50	50+

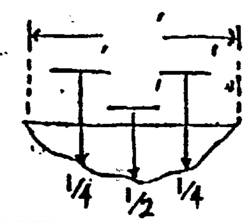


Figure 2. Stream Survey Form

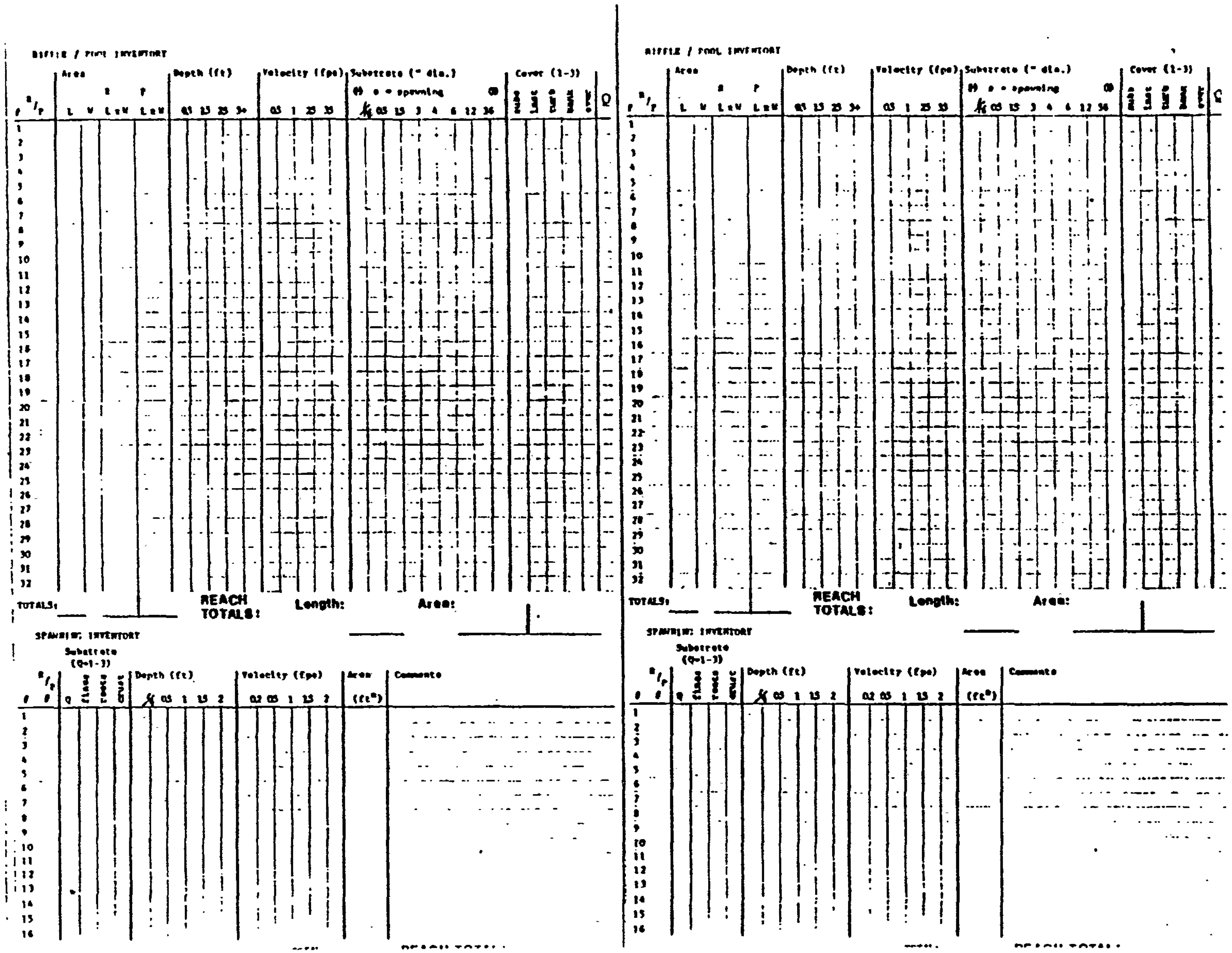


Figure 2 (cont.)

determine the sequence that will be needed to obtain ratings for 16 pools. The surveyor will then rate from every pool in a section to every iourth pool until they reach 16. In this way pools will be randomly selected before the section is surveyed. Riffles will be randomly selected for measurement and quality ratings as the surveyor moves through a section. Due to the homogeneous habitat in the main stem of Trout Creek and some larger tributaries, 1/2 mile instead of 1/4 mile sections will be done. This will cut the time involved in surveying without affecting quality. All other portions of the survey format were retained as described in the methodology.

3. Aerial Photo Interpretation. The Trout Creek watershed color aerial photos (scale 1:3,00) and USGS Quad maps, along with additional reference materials, were evaluated for instream and stream bed features. These features were mapped on draft overlays of USGS maps at a 1:24,000 scale. Ground truthing was also done to verify the locations and significance of some of the features.

Limiting factors such as bank erosion, poor pool to riffle ratios, migrational barriers and irrigation diversions were all incorporated into the aerial photo interpretations. The geomorphology of the basin was also considered in this analysis. This information was used to establish habitat groups, in relation to fisheries resources. The habitat groups are simply collections of similar reaches of streams. Information on aspect, gradient, location, and riparian cover were also incorporated in the delineation of the habitat groups.

Habitat Groups (see Figure 9)

Group 1. This group incorporates Trout Creek RM (River Mile) 0 to 16, Trout Creek RM 25-39, and Antelope Creek RM 0-4.5. These reaches are characterized by frequent cut banks and little or no riparian cover. Apparently, the Army Corps of Engineers completely channelized the mainstem of Trout Creek (except RM 16-25) and the stream is still recovering. This work has produced a highly unstable channel. The few pools present are very long and pool to riffle ratios are about 2 to 8. Most of the water diversions in the basin occur in these stream lengths and are of two types, pump and ditch. A berm of gravel was usually constructed to funnel water towards the diversions. None of the diversions were screened and steelhead are probably being trapped in the irrigation ditches. During normal water years the creek is probably intermittent and water temperatures would be elevated. The stream area is also heavily grazed during the winter, and this will continually contribute to the degraded condition of the riparian vegation.

The apparent limiting factors for fish production are:

1) severe streambank erosion
2) low stream shading
3) poor pool cover
4) unscreened irrigation diversions
5) low base flows
6) elevated water temperature

Group 2. This group incorporates Trout Creek RM 16-25 and the Ward Creek watershed. Since these stream sections flow through steep canyons, there is a high amount of aspect shading. Also, the riparian cover is denser along these stream reaches than anywhere else in the Trout Creek watershed. The rearing quality should be extremely good. Pools are formed near the canyon walls and should be relatively deep. Pool to riffle ratios are also favorable for juvenile steelhead rearing. There appears to be a small amount of bank cutting, but only at a few sites.

Group 3. This group includes lower Hay Creek (RM 0-12) and upper Antelope Creek (RM 4.5-14). Streams in this grouping are highly channelized and have a significant amount of streambank erosion. The channel has also been incised greatly, and apparent migrational barriers (waterfalls) were lcoated on each creek (RM 2.0 on Hay Creek, RM 4.5 on Antelope Creek). Upstream from the migrational barriers, the stream channel is narrow, with virtually no riparian cover. In normal years the creeks are probably intermittent streams. These reaches appear to have limited value in terms of salmonid rearing.

The apparent limiting factors for fish production are:

1) severe streambank erosion
2) low stream shading
3) unscreened irrigation diversions
4) low base flows
5) elevated water temperatures
6) migrational barriers.

Group 4. This group incorporates Trout Creek RM 39-46, Foley Creek, Opal Creek, and their tributaries. These streams are characterized by a moderate amount of shading, both riparian and aspect, some channel encroachment by the road riprap, and a low pool to riffle ratio. Because summer steelhead generally use the upper sections of watersheds, it is assumed that these reaches would be important for spawning and rearing.

The apparent limiting factors for fish production are:

1) low amount of pool habitat
2) low base flows

Group 5. This group includes Ten Mile Creek, Board Hollow Creek, Clover Springs Creek, Big Whetstone Creek, and Amity Creek. These perennial streams are large tributaries to Trout Creek. Most are spring-fed, and have a high seasonal runoff. Low summer flows restrict salmonid rearing. However, these creeks are probably important spawning tributaries.

The apparent limiting factors for fish production are:

1) low amount of pool habitat
2) low base flows

Group 6. This grouping includes Little Trout Creek, Tub Springs Creek, Thompson Creek, and Gooseberry Creek. These watersheds generally have an east/west orientation, and are dry or intermittent, with little riparian cover. The dry channel is generally wide, which indicates that there are high season flows. This evidence also suggests that these tributaries are probably important for spawning habitat, but not rearing habitat.

The apparent limiting factors for fish production are:

1) low base flows
2) elevated water temperatures

Group 7. This group incorporates Indian Spring Creek, Cold Springs Creek, Grub Hollow Creek, and Mud Springs Creek. Indian Spring, Cold Camp, and Grub Hollow Creeks all enter Antelope Creek above the waterfall on the mainstem (RM 4.5). Mud Springs Creek is a tributary to Trout Creek. It has several large waterfalls near its mouth because the original channel was moved, probably during railroad construction. All of the streams have a good summer base flow. Indian Spring, Cold Camp Creek, and Grub Hollow Creek flow out of highly dissected basaltic material. These upper areas have many springs which feed the creeks. The irrigators in the Mud Springs watershed use diverted Deschutes River water and most of the return flow enters lower Trout Creek. At present, none of these creeks are important in terms of steelhead production, but they are significant contributors of cool water to the Trout Creek basin.

The apparent limiting factors for fish production are:

1) poor access for migratory fish
2) poor pool cover
3) severe streambank erosion

Conclusions

Water and related resource problems appear to be the major limiting factors for steelhead production in the Trout Creek Watershed. The average annual precipitation is low and most of the creeks have intermittent flows during the critical low flow period. The stream channel for most of the basin is wide and shallow, and water temperatures usually exceed the upper limit preferred by rearing steelhead. Because of intensive grazing and watershed alterations, the riparian habitat has also been severely degraded. In addition, most of Trout Creek is appropriated for irrigation and there are several unscreened water diversions which operate during the downstream migration of steelhead juveniles.

Historically, the watershed supported chinook salmon, steelhead trout, and rainbow trout populations. Presently, the basin only supports a run of approximately 250 adult summer steelhead, and some rainbow trout. The degraded habitat of Trout Creek has been the primary factor for the declining production of salmonids. However, the Trout Creek Watershed still retains a substantial potential for increased wild fish stock production. The estimate of annual anadromous salmonid spawning increase from riparian restoration alone is approximatley 1,300 adult spawners (USFWS and NMFS, 1981). Obviously, the Trout Creek Watershed could be a major tributary for the production of anadromous salmonids.

HYDROLOGY

Climate

Climate of the Trout Creek watershed was determined from climatological data published by the National Weather Service in Climatological Data for Oregon and data analyzed by the Oregon State Climatologist and contained in Soil Survey of Trout Creek-Shaniko Area, Oregon, jointly published by the Soil Conservation Service and the Forest Service.

The climate of Trout Creek basin, which is classified as semi-arid, is strongly influenced by the Oregon Coast Range and the Cascade Mountains to the west. Moist air flowing from the Pacific Ocean loses most of its moisture as it cools in passing over the two mountain ranges. Consequently, the air is very dry as it moves down the eastern slope of the Cascades and into the Trout Creek region. Precipitation increases with elevation in the Ochoco Mountains at the south end of the Trout Creek watershed.

There are two distinct climatic regimes in the Trout Creek basin--the plateau, which covers roughly 80% of the watershed, and the slopes of the Ochoco Mountains. Table 1 gives the temperature and precipitation data for each of these two areas. Data are based on records from stations both within and outside of the basin.

Average annual precipitation ranges from 10 inches along the western boundary of the Trout Creek watershed to roughly 25 inches in the southeastern corner of the watershed (Figure 3). Mean basin precipitation is about 16 inches per year. According to long-term weather records for Madras and Antelope, approximately 34% of average annual precipitation occurs from December through February, 23% from March through April, 16% from June through August, and 27% from September through November.

During the driest period of the year, from July through September, only about 11% of the average annual precipitation occurs. There are 50-65 days a year when 0.10 inches or more of precipitation occurs. In the Ochoco Mountains this increases to 75-100 days per year.

TABLE 1.—*Temperature and precipitation data* [1]

PLATEAU AREA

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: 2 years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	Temperature: 2 years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Precipitation: Average precipitation	Precipitation: 1 year in 10 will have— Less than—	Precipitation: 1 year in 10 will have— More than—	Precipitation: 4 years in 10 will have— Less than—	Precipitation: 4 years in 10 will have— More than—	Precipitation: Average snowfall	Precipitation: Maximum depth of snow on ground	Precipitation: Maximum number of days that have snow cover	Precipitation: Average depth of snow on days that have snow cover
	°F.	°F.	°F.	°F.	In.	In.	In.	In.	In.	In.	In.		In.
January	40	21	54	−1	1.3	0.5	2.2	0.9	1.4	6	19	8	4
February	46	25	58	7	1.0	.4	2.0	.7	1.0	4	18	5	5
March	52	27	68	15	.9	.2	2.1	.6	.9	2	6	1	2
April	61	31	77	20	.7	.1	1.8	.5	.8	1	3	(3)	2
May	68	36	85	25	1.1	.2	2.8	.9	1.1	(3)	(3)	0	0
June	76	42	92	32	1.0	.2	2.3	.8	1.0	(3)	0	0	0
July	87	47	98	36	.2	.1	.8	.2	.3	0	0	0	0
August	85	45	97	35	.3	.1	1.2	.2	.3	0	0	0	0
September	77	40	92	29	.5	.2	1.4	.3	.5	0	0	0	0
October	65	33	81	21	1.0	.2	2.0	.6	.9	(3)	3	(3)	3
November	50	27	63	12	1.4	.3	2.9	1.3	1.6	1	7	1	2
December	43	25	57	9	1.4	.4	2.7	1.0	1.7	3	8	2	2
Annual	63	33	[4] 98	[5] −8	10.8	6.9	14.8	10.6	12.1	17	19	17	4

OCHOCO MOUNTAINS

Month	Average daily maximum	Average daily minimum	Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Average precipitation	1 in 10 Less than—	1 in 10 More than—	4 in 10 Less than—	4 in 10 More than—	Average snowfall	Maximum depth of snow on ground	Maximum number of days that have snow cover	Average depth of snow on days that have snow cover
January	35	15	46	−6	2.2	.8	3.4	1.7	2.5	19	43	28	11
February	41	20	51	4	1.8	.5	3.1	1.3	1.8	12	36	26	14
March	47	22	62	11	1.6	.5	2.5	1.3	1.6	10	34	19	11
April	54	27	73	18	1.3	.2	2.1	1.1	1.3	3	15	1	4
May	64	32	80	23	1.7	.5	3.8	1.1	1.7	(3)	4	(3)	2
June	71	37	86	28	1.7	.2	3.6	1.3	1.7	(3)	2	(3)	1
July	82	41	93	32	.6	.1	1.4	.4	.5	0	0	0	0
August	81	39	92	31	.7	.1	2.1	.2	.7	0	0	0	0
September	75	35	89	26	.7	.1	1.5	.5	.8	(3)	0	0	0
October	61	30	77	22	1.7	.7	3.8	1.1	1.5	1	5	1	3
November	44	24	57	12	2.6	.9	4.6	2.3	2.7	7	14	7	4
December	37	20	47	5	2.8	1.0	5.4	1.9	[illegible]	12	26	19	7
Annual	58	29	[4] 96	[5] −11	19.4	12.6	25.3	17	[illegible]	64	43	101	10

[1] These are the best estimates if conditions are average. Because of differences in exposure and elevation, there are probably locations within divisions that differ from the value shown for particular months by as much as 5 to 10 percent.

[3] Less than one-half inch.

[4] Average annual maximum temperature.

[5] Average annual minimum temperature.

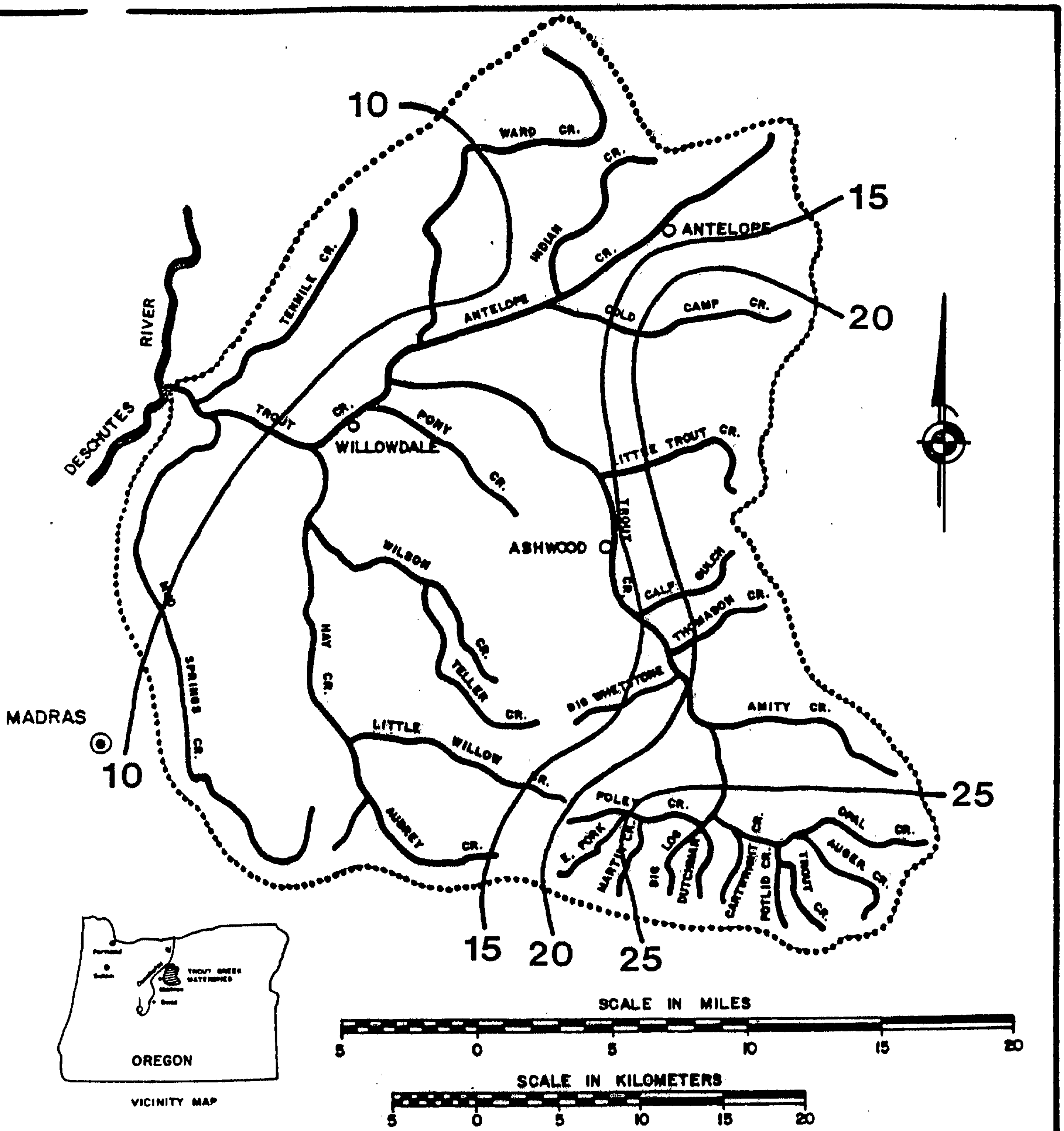


Figure 3. ISOHYETS OF ANNUAL PRECIPITATION IN INCHES

TROUT CREEK WATERSHED

At the lower elevations most precipitation falls as rain. There are only 6-8 days a year when snow accumulates to depths of an inch or more. Typically, this snow melts within hours or a few days at most. In the Ochoco Mountains about a fourth to a third of annual precipitation falls as snow. Snow depth may reach 3-4 feet, but a depth of only 15-30 inches is common in most winters.

Thunderstorms have occurred in the Trout Creek watershed every month of the year but are most likely to occur in late spring and throughout the summer. Rainfall intensities during thunderstorms are relatively high but of short duration and generally confined to small areas. Nonetheless, thunderstorms can cause localized flooding and soil erosion.

Streamflow

The stream system in the Trout creek drainage is typical of semi-arid areas that have some elevations high enough to receive snow. The majority of streams head in the Ochoco Mountains in the southeastern part of the Trout Creek drainage where annual precipitation is sufficient to suggest forest vegetation. The upper tributaries of Trout Creek (Amity, Potlid, Big Log, Martin, and Foley Creeks) and of Hay Creek (Little Willow and Aubrey Creeks) are perennial streams whose flows are dependent on snowmelt in the Ochoco Mountains. Other perennial streams are maintained by springs located in the 3,500-4,000 foot elevation, for example in the upper Trout Creek watershed and immediately to the west in the Hay Creek watershed.

Streamflow data are scarce for the Trout Creek watershed. The Oregon State Water Resources Department maintains a continuously recording gage on Trout Creek below Amity Creek. This gage measures streamflow from the generally forested 120 square mile watershed in the northern portion of the Ochoco Mountains, where annual precipitation and runoff are much higher than elsewhere in the Trout Creek watershed. Accuracy of streamflow measurements at this gaging station range from "poor" to "fair".

Streamflow was measured in Trout Creek 1-1/2 miles upstream from Antelope Creek from 1915 to 1917 and in Hay Creek downstream from Little Willow Creek in 1915 and 1916. These data are of little value and have not been included in any analysis. In addition, a number of crest state gaging stations have been operated throughout the Trout Creek basin, including in Woods Hollow at Ashwood (1960-1979), Antelope Creek at Antelope (1959-1979), and at Sagebrush Creek tributary near Gateway (1957-1982). With the exception of the Woods Hollow site, where flow is measured at a culvert outlet from a stock-watering pond, all crest gaging stations consist of flow through culverts placed in stream channels.

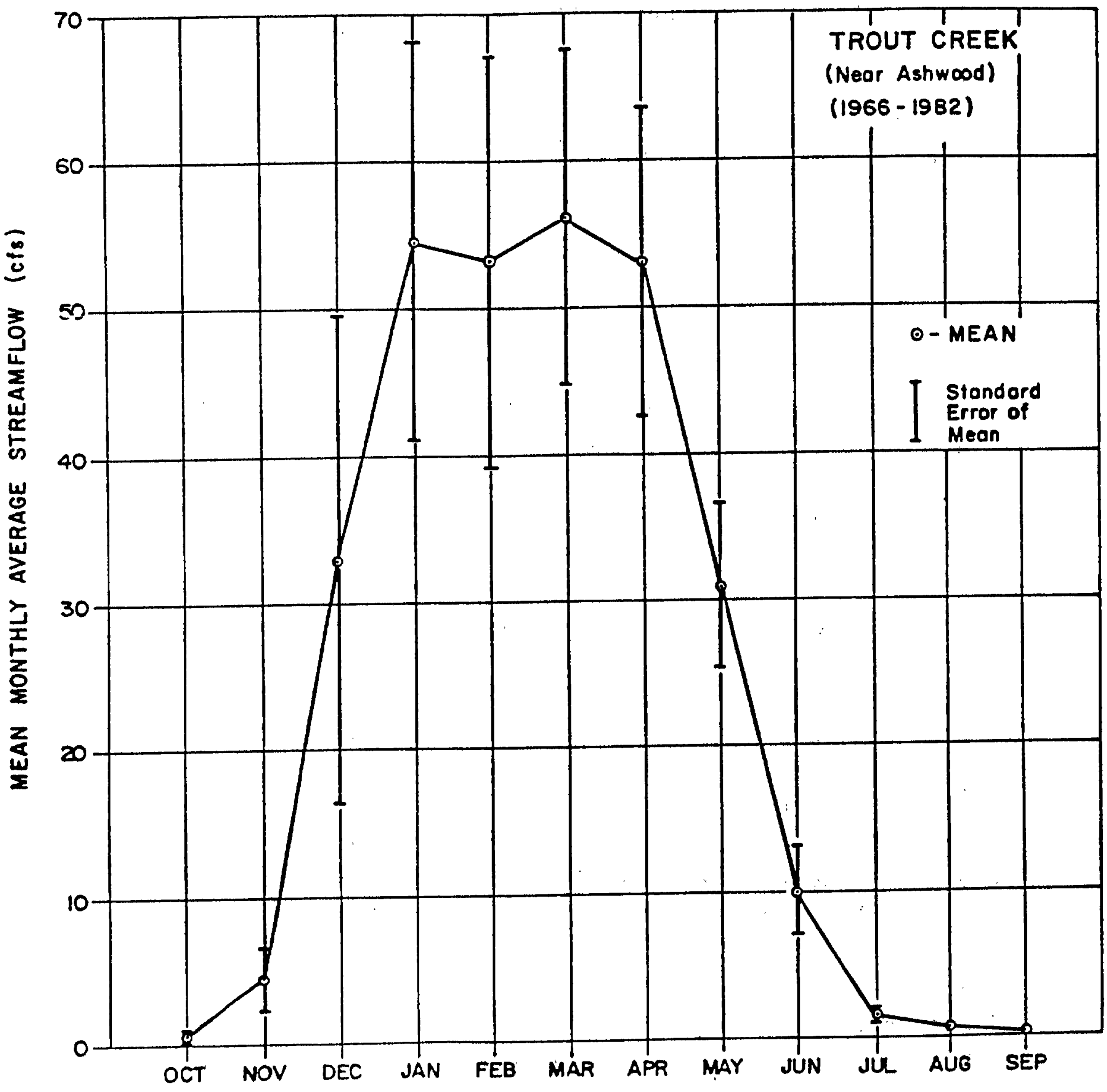
Annual Distribution of Streamflow

Table 2 gives the mean monthly average flows in cubic feet per second (cfs) for Trout Creek below Amity Creek. These flows were derived from streamflow data compiled and published by the State of Oregon Water Resources Department for water years 1966-1974, 1976-1978, and 1981-1982. Also given are the range for each month and the standard error of each mean. Means and standard errors are plotted in Figure 4.

Table 2. M[illegible]n, minimum, and maximum monthly average flows and standard er[illegible]s of means for Trout Creek below Amity Creek, 1966-1982.

	Mean	Minimum	Maximum	Standard Error	Frequency of Annual Monthly Maximum
Oct	0.62	0	2.7	0.21	0
Nov	4.68	0.26	28.7	2.15	0
Dec	33.0	1.8	107	16.74	0
Jan	54.6	6.8	130	13.43	2
Feb	53.2	6.5	75.6	14.04	2
Mar	56.1	3.5	156	11.51	3
Apr	53.0	3.6	126	10.62	3
May	30.9	1.8	59.0	5.72	1
June	10.0	0.63	37.8	2.98	0
Jul	1.67	0	5.7	0.50	0
Aug	0.54	0	5.2	0.37	0
Sep	0.24	0	0.65	0.09	0

FIGURE 6. MEAN MONTHLY AVERAGE STREAMFLOW AND STANDARD ERRORS OF MEANS FOR TROUT CREEK BELOW AMITY CREEK, 1966 - 1982.



Source: State of Oregon Water Resources Department

Table 1 and Figure 4 illustrate the bi-modal pattern of annual run-off indicative of much of eastern Oregon. In any given year maximum, monthly average flows may occur in January or February as a result of snowmelt during rainfall or in March or April or even May, primarily as a result of snowmelt.

Streamflow thoughout the Trout Creek basin is not well-distributed throughout the year. Low summer precipitation coupled with high evaporative demand results in extremely low streamflows in summer and early fall. On a unit area basis, the Trout Creek watershed yields about 1.3 inches per year. This amounts to about 49,000 acre-feet per year. The drainage area upstream from the Trout Creek stream gage below Amity Creek (Trout Creek river mile 36.2) yields 2.8 inches on the average. This totals about 18,000 acre-feet per year. Thus, 17% of the Trout Creek basin accounts for 37% of the water yield of Trout Creek at its mouth.

About 2,100 acres are irrigated in the Trout Creek drainage. Because the irrigation season corresponds to the low-flow period, water used for irrigation and lost to evaporation or transpiration by plants further aggravates the summer low-flow situation. Trout Creek flows are over appropriated and are not adequate to meet irrigation needs in normal water years.

Peak Flows

Over the 12 years of streamflow record at Trout Creek below Amity Creek, annual maximum instantaneous peak flows have ranged from only 25 cfs in 1977 to 3,000 cfs in 1974. Of the six measured flows greater than 50 cfs, five have occurred in January during Chinook conditions when rapid melting of snowpacks is caused by warm winds and rainfall. Of the six smaller annual maximum flows, three have occurred in March, one each in February, May, and August. The peak flow of August 6, 1976 resulted from a thunderstorm over the Ochoco Mountains.

Annual maximum instantaneous peak streamflows were tabulated (Table 3) and plotted, and a log-Pearson Type III distribution was fitted to the data according to procedures outlined by the U.S. Water Resources Council (1976).

Table 3. Ranking of annual maximum instantaneous peak streamflows at Trout Creek below Amity creek, 1966-1978.

Ranking(m)	Peak Flow (cfs)	Date of Flow	Return Period(Tr) (yr)	Quality of Flow Measurement
1	3,000	1-18-74	13	Poor
2	2,160	4-26-78	6.5	Fair
3	1,730	1-17-71	4.3	Good
4	707	1-20-72	3.2	Good
5	654	1-30-70	2.6	Fair
6	546	1-28-67	2.2	Poor
7	251	3-30-69	1.9	Fair
8	149	2-21-68	1.6	Fair
9	143	3-13-66	1.4	Poor
10	86	8-06-76	1.3	Fair
11	33	3-01-73	1.2	Good
12	25	5-10-77	1.1	Fair

Flow rates and return periods are plotted on probability paper Figure 5. Plotting positions of peak flows were determined by the Weibull formula

$$T_r = \frac{N + 1}{M}$$

where T_r = return period in years, N = number of years of record, and M = ranking of peak flow among all annual peak flows of record. From this frequency analysis, peak flows of 2-, 5-, and 10-year return periods are estimated to 320 cfs, 1,200 cfs, and 2,400 cfs, respectively. Extension of the frequency curve yields a 20-year peak flow of 4,200 cfs. Statistics used in this analysis are given in Appendix F.

Because of the relatively short period of record available for Trout Creek below Amity Creek, the estimated sizes of the 2-, 5-, and 10-year peak flows may be larger or smaller than estimated flows would be if the length of record were several times greater. It is desirable to compare the Trout Creek data with that of adjacent or nearby watersheds with physiographic characteristics similar to those of upper Trout Creek, and adjust the Trout Creek estimated flows. Howewver, no nearby stations could be used because they either had flows regulated by upstream dams and reservoirs, they contained considerably more high elevation land than does Trout Creek, or their lengths of record were too short. Consequently, the two streams chosen for the comparative analysis with Trout Creek are both in the John Day watershed to the east of Trout Creek. One stream, Camas Creek near Ukiah, Oregon (USGS Station 14042500) drains 121 square miles compared to 120 square miles for Trout Creek. The other stream, the North Fork John Day River (USGS Station 14046000) at Monument, Oregon, drains 2,520 square miles, an area about 3.5 times greater than the entire Trout Creek wataershed.

Tables 4 and 5 show the ranking of the 20 highest annual maximum instantaneous peak streamflows at Camas Creek and the North Fork John Day River. Again, return periods were determined using the Weibull formula, and peak flows are plotted in Figures 6 and 7. Summary statistics for the log-Pearson Type II frequency analysis are given in Appendices G and H.

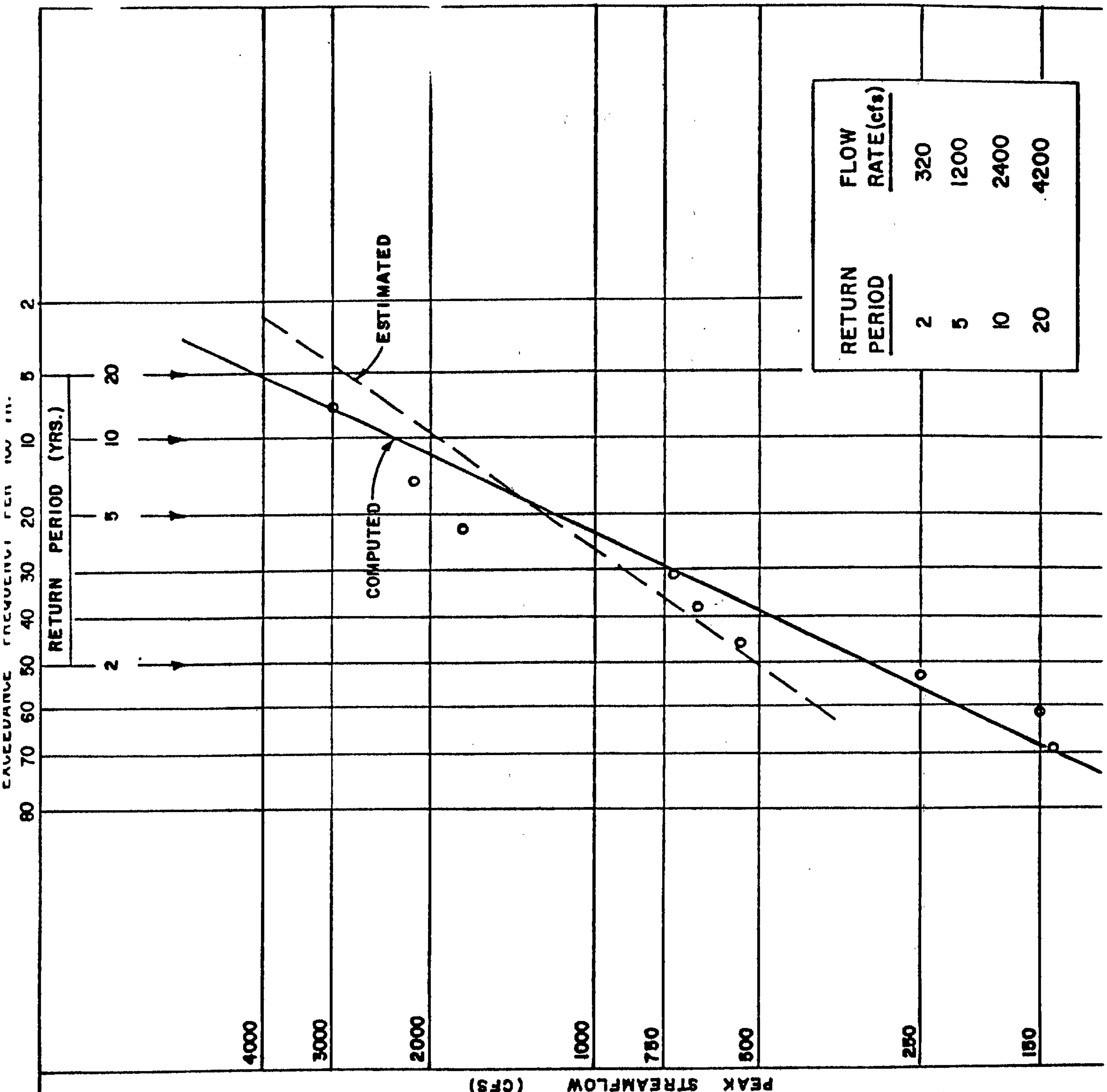


FIGURE 5.

LOG-PEARSON TYPE III DISTRIBUTION
TROUT CREEK BELOW AMITY CREEK
(1966-1978)
WEIBULL PLOTTING POSITION

Table 4. Ranking of 20 highest annual maximum instantaneous peak streamflows of Camas Creek near Ukiah, Oregon, 1932-1981.

Ranking (m)	Peak Flow (cfs)	Date of Flow	Return Period (Tr) (yr)
1	3840	1-30-65	51
2	2600	3-18-32	25.5
3	2510	5-08-56	17
4	2380	3-13-72	12.8
5	2350	11-12-47	10.2
6	2080	5-08-52	8.5
7	1860	1-07-48	7.3
8	1650	4-05-57	6.4
9	1600	3-27-43	5.7
10	1570	1-16-74	5.1
11	1540	1-23-70	4.6
12	1430	12-11-59	4.2
13	1300	1-25-75	3.9
14	1230	4-08-76	3.6
15	1220	3-22-39	3.4
16	1190	4-28-79	3.2
17	1180	12-29-46	3.0
18	1150	4-14-37	2.8
19	1130	3-25-60	2.7
20	1110	5-05-55	2.6

Table 5. Ranking of 20 highest annual maximum instantaneous peak streamflows of North Fork John Day River at Monument, Oregon 1925-1981.

Ranking (m)	Peak Flow (cfs)	Date of Flow	Return Period (Tr) (yr)
1	33,400	1-30-65	58
2	22,000	3-18-32	29
3	21,100	5-22-48	19.3
4	20,900	3-26-52	14.5
5	20,200	5-08-56	11.6
6	19,500	3-13-72	9.7
7	18,900	1-17-74	8.3
8	18,000	1-24-70	7.2
9	13,600 (2)	3-28-43	6.4
10		1-18-71	
11	13,500	5-06-79	5.3
12	13,400	12-29-45	4.8
13	13,000	4-28-78	4.5
14	12,000	5-12-58	4.1
15	11,900	4-28-53	3.9
16	11,800	4-01-31	3.6
17	11,000	3-25-39	3.4
18	10,400 (2)	2-26-57	3.2
19		5-15-75	
20	10,200 (2)	4-15-37	2.9
		2-28-40	

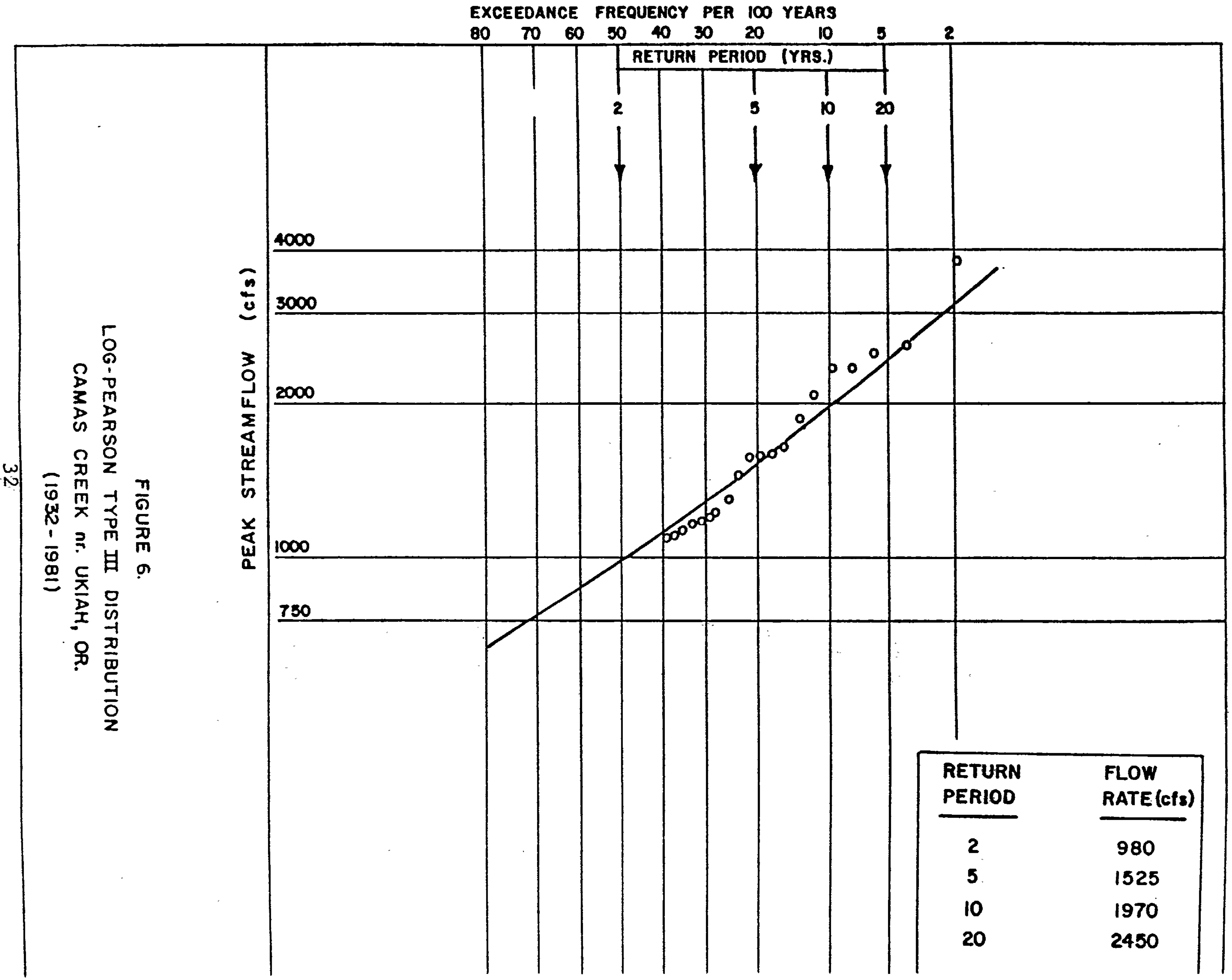
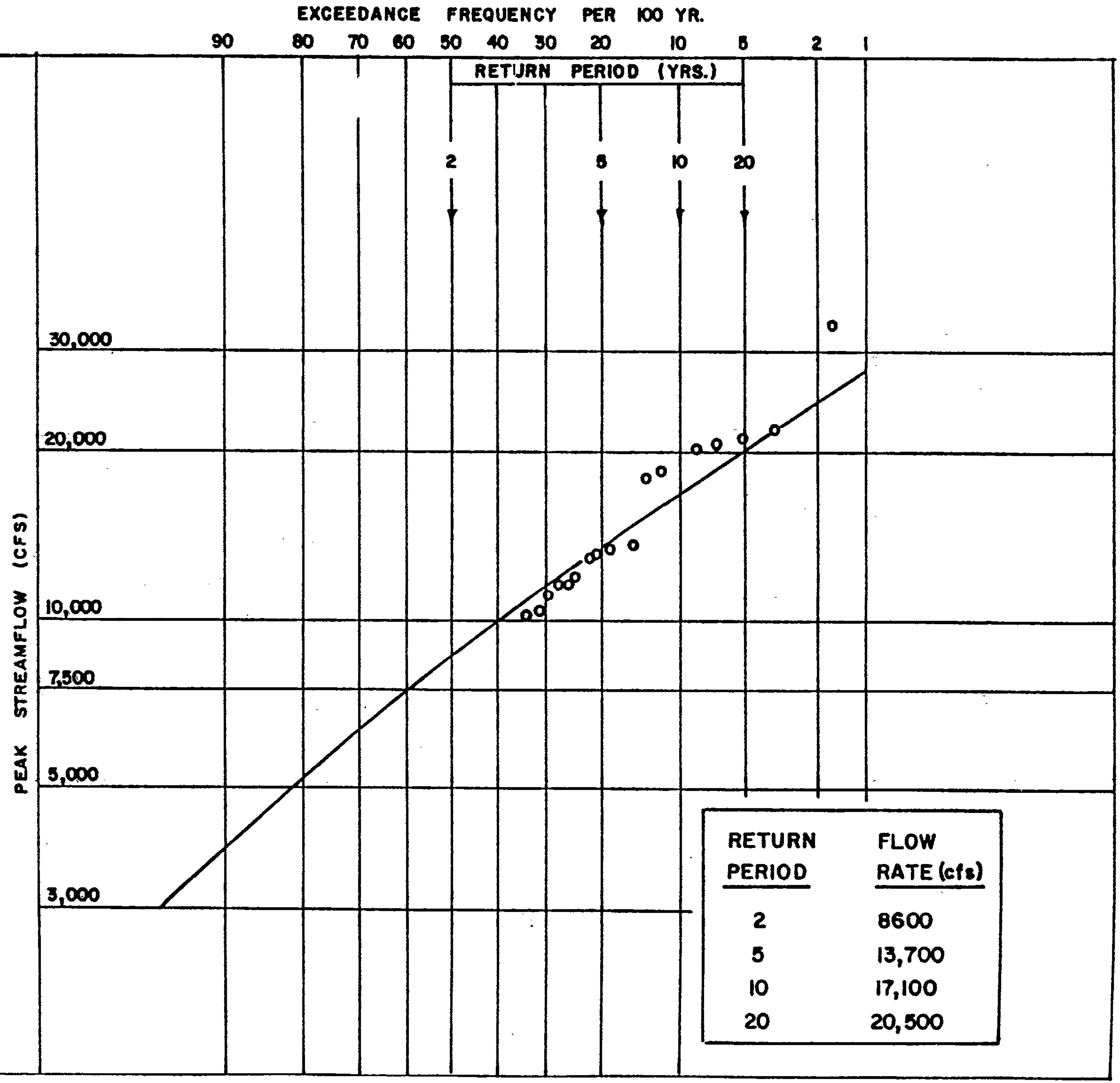


FIGURE 6.
LOG-PEARSON TYPE III DISTRIBUTION
CAMAS CREEK nr. UKIAH, OR.
(1932-1981)

FIGURE 7.
LOG-PEARSON TYPE III DISTRIBUTION
NORTH FORK JOHN DAY RIVER
(1925-1981)



Because of the relatively short-term record of streamflow of Trout Creek, estimated two and five year peak flows are lower than those of Camas Creek where length of record is 43 years. Also, estimated 10 and 20 year peak flows of Trout Creek are higher. Direct comparison of specific peak flows betrween Tables 3 and 4 can be made in only one case, the event of January, 1974. This event was the largest in the record of Trout Creek but was ranked only tenth for Camas Creek. This probably reflects the lower elevation of upper Trout Creek and greater melt during rainfall at Trout Creek in January, 1974.

The highest instantaneous flow measured in many streams in eastern Oregon occured on January 30, 1965, as was the case of both Camas Creek and North Fork John Day River. Not shown in Table 6 or 7 is the second largest flow of record in much of eastern Oregon, that of late December, 1964. Tables 4 and 5 and Figures 4 and 5 represent annual series flood analyses. Consequently, only the highest flow in the 1965 water year is listed, that of January 30, 1965. Had the stream gage in Trout Creek below Amity Creek been in operation during the 1965 water year, both the December, 1964 and the January, 1965 flows probably would have exceeded the highest flow measured at Trout Creek between 1966 and 1978.

If the length of record at Trout Creek were longer, say 50 years, then the January 18, 1974 flow would have been ranked no higher than second. Also, more flow between 720 and 1730 cfs probably would have occured over the 50-year period than occured during the actual period of record. The resultant flow frequency curve would be less steep than that shown by the solid line in Figure 5. The dashed line in Figure 5 is an estimate of what the flood frequency curve would be if length of flow record were 50 years. Sizes of the 2, 5, 10, and 20 year flows would be 500, 1,250, 2,000, and 2,900 cfs, respectively. These adjusted estimates provide the basis for estimating flows of similar return periods elsewhere in the Trout Creek drainage.

In Water-Supply Paper 1689, the U.S. Geological Survey developed an equation for estimating the mean annual peak flow based on drainage area, mean annual runoff, area of lakes, ponds, etc. and geographical considerations. The equation is given by

$$Q = 2.36\ A^{0.80}\ R^{0.62}\ L^{-0.17}\ G$$

where Q = mean annual peak flow; A = watershed area in square miles; R = mean annual runoff in inches; L = proportion of watershed in lakes, ponds, etc.; and G = geographic factor. For Camas Creek and the North Fork John Day River, the mean annual peak flow determined by the above equation agrees well with that determined form the log-Pearson frequency analyses. For Camas Creek, the USGS equation estimates 1,200 cfs compared to 1,100 cfs by the log-Pearson method. For the North Fork John Day River, the respective estimates are 9,220 cfs and 9,500 cfs. For Trout Creek below Amity Creek the respective estimates are 370 cfs and 320 cfs, much lower than the 500 cfs estimated from the adjusted curve in Figure 5. For the USGS equation to estimate a mean annual peak of 500 cfs at Trout Creek would necessitate a mean annual runoff at Trout Creek of 4.3 inches. This tends to support the position of the lower end of the dashed line in Figure 5, an amount well above the mean of 2.8 inches determined. However, given a longer period of record, which could include the wetter years in the 1940's and 1950's, and the relatively poor accuracy of streamflow measurements at Trout Creek below Amity Creek, average annual runoff from Trout Creek could be higher than 2.8 inches.

The USGS equation was used to estimate mean annual peak flow for five other locations in the Trout Creek drainage (Table 6 and 7). Mean annual runoff for the various watersheds was estimated by comparing mean elevation of each watershed with that of two watersheds whose mean annual runoff has been computed. A straight-line relationship was assumed between 1.3 inches of runoff for 3100 foot Trout Creek basis and 2.8 inces for 4100 foot upper Trout Creek watershed.

Table 6. Values used in USGS Equation $Q = 2.36\ A^{0.8}\ R^{0.62}\ L^{-0.17}\ G$ to produce the results shown in Table 7.

Watershed	River Mile	Approx. Mean Elev. (ft.)	A (mi²)	R (in)	L (%)	G	Q (cfs)	Q Adj. (cfs)
Trout Creek	36.2	4100	120	2.8	.01	0.8	370	500
	25.3	3500	218	2.0	.01	0.8	470	640
	12.2	3000	414	1.3	.01	0.8	605	820
	8.2	3100	573	1.3	.01	0.8	785	1060
Antelope Creek	8.7	3100	83	1.3	.01	0.8	167	230
	2.2	3500	155	2.0	.01	0.8	360	490

Table 7. Estimated size of peak flows at five locations in the Trout Creek drainage.

Watershed	River Mile	Estimated size of peak flow at 2 yr	5 yr	10 yr	20 yr
		---------- cfs --------			
Trout Creek	36.2	500	1250	2000	2900
	25.3	640	1600	2560	3700
	12.2	820	2050	3280	4750
	8.2	1060	2650	4240	6150
Antelope Creek	8.7	230	580	920	1330
	2.2	490	1230	1960	2840

GEOMORPHOLOGY

Introduction

Streambank landforms are strongly influenced by the terrain through which the streams flow. A brief description of the rocks and landforms making up the approximately 480,000 acres of the Trout Creek watershed will help the reader to understand the categories into which riparian landforms have been divided.

Physiography of Trout Creek Basin

The Trout Creek drainage is essentially a rolling plateau which varies in elevation from about 2,000 feet at Agency plain, in the northwest, to 6,000 feet in the Ochoco Mountains in the southeast. Into this rolling landscape, Trout Creek and its major tributaries have eroded broad valleys and steep canyons. Where the rocks are hard and strong, as in Degner Canyon, the canyons approach 1,000 feet in depth and are quite spectacular. Where rocks are soft and weak, as along Mud Springs Creek, the middle reaches of Antelope Creek and the lower portion of Hay Creek, the valleys are a mile or more wide and may lack definite boundaries.

Geology

That portion of the drainage lying north and west of Antelope Creek and lower Trout Creek (about 1/6 of the basin) is underlain by nearly level, hard and much fractured Columbia River Basalts. This area includes the entire drainages of Tenmile, Ward and Indian Spring Creeks. Shallow, very stoney soils predominate in the watersheds of these three tributaries. These soils are capable of absorbing only about 3 inches of rainfall. They therefore, contribute a great deal of rapid runoff to their respective streams even though the average annual precipitation is only 10 to 15 inches. In contrast, that portion of the drainage lying west of Trout Creek (about 1/7 of the basin) is underlain by poorly cemented sands and gravels with a partial cap of lava flow. Soils are primarily sandy and loamy. They are capable of absorbing a large part of the 10 to 15 inches of precipitation which they receive and so yield relatively little runoff.

Approximately 1/10 of the drainage (at the southern margin) is covered by coniferous timber. Much of this portion lies in Crook County and is administered by Ochoco National Forest. Precipitation in this portion is relatively high, 20 to 25 inches annually, and much of it falls as snow. Soils are primarily deep and many have a surface layer of volcanic ash. Much of the runoff from tributaries in this area occurs primarily in spring and early summer. Conversely, these tributaries are less important contributors to peak winter flows.

By far the largest portion (nearly 2/3) of the Trout Creek drainage is underlain by the John Day and Clarno formations. These formations contain an abundance of silty volcanic ash, which gives rise to clayey soils, interspersed with occasional hard lava flows, which form prominent cliffs, such as those in Degner and Devil's Canyons. Precipitation ranges from 15 to 20 inches, much of which runs off quickly because the soils are either too shallow or clayey to absorb it rapidly enough. Streambank erosion during peak winter flows in this area contributes much of the fine sediment which results in silting of spawning gravels further down in the drainage.

Major portions of lower Trout Creek, lower Hay Creek and middle Antelope Creek flow through wide valleys partially filled with recently deposited sand, silt and clays. Streambanks in these areas are particularly susceptible to erosion when riparian vegetation is insufficient to stabilize them.

Objective

The basic objective in classifying the riparian landforms of the Trout Creek drainage is to group the wide range of physical characteristics encountered in the field into a limited number of classes. This approach will permit a rapid stratification of the entire drainage into comprehensible divisions by photo interpretation. The intent is that physical conditions will be relatively uniform within each class. For example, reaches of separate streams which are mapped as a given unit should have very similar physical characteristics and hence similar management techniques should be appropriate, if they have similar fishery problems.

Methods

Initial classes were selected after inspection of watershed topographic maps, 1:3,000 air photos, and consultation with project team members. During photo interpretation, approximately one third of the stream miles were observed directly or from low flying aircraft. After a representative sample of the drainage had been mapped on aerial photos using the preliminary categories, the mapping was verified in the field. The categories were slightly altered as a result of field inspection. Revised classes were then mapped directly on to 1:24,000 topographic maps, using the 1:3,000 true color air photos as an interpretative tool. Transparent overlays were drafted from these manuscript copies.

Description of Classes

R = Rock Outcrop. These areas are usually steep (cliffs) and nearly devoid of vegetation. In the forested zone they may support a sparse tree canopy. This unit forms the most stable streambank, and is a source of large, pool-forming boulders.

Ru = Rubble (Talus slope). These areas include steeply sloping accumulations of cobbles and boulders, usually below a rock outcrop. These areas are also usually devoid of vegetation, but may support a moderately dense stand of timber in the forested zone. This unit forms a quite stable streambank and is a source of cobbles and boulders.

Fa = Fan. This unit consists of moderately sloping deposits of cobbles, gravel and sand, which occur where small intermittent (or ephemeral) streams join a larger one. This unit is moderately resistant to undercutting and is a good source of gravel and cobbles.

T = Terrace. These areas consist of nearly level alluvial deposits of sand, silt and gravel. Streams erode these deposits rapidly if they are not well-stabilized by vegetation. They are a major source of fine sediments which can clog spawning gravel.

U = Upland. These areas include primarily those headwaters in which the streambanks are no different from the surrounding soils. Depth to bedrock averages less than five feet. Stream course tends to be stable laterally but is susceptible to downcutting if the watershed is overgrazed or riparian vegetation is seriously depleted.

C = Colluvium. These are primarily headwater areas in which streambanks consist of a mixture of cobbles, boulders and clay. Depth to bedrock is greater than five feet. These areas are a source of cobbles and boulders as well as a potential source of turbidity.

L = Landslide. This unit occurs only rarely in the Trout Creek drainage. It denotes areas where presently active landslides are displacing the streambed. These areas, though small, are a source of cobbles, boulders, and fine sediments.

Md = Meadow, dry. These areas are alluvial deposits with natural grass vegetation. Water table tends to be below rooting depth in the late summer and early fall months. Surface flow during theses months may be discontinuous.

Mw = Meadow, wet. These areas are alluvial deposits with natural grass vegetation. Water table tends to remain within reach of plant roots for most of the growing season. Surface flow therefore has a higher probability of being continuous during that time.

Fn = Floodplain, narrow. The streambed (<125 feet wide) occupied by high-volume winter flows contain sufficient perennial vegetation to stablize it.

Fw - Floodplain, wide. The streambed (>125 feet wide) occupied by high-volume winter flows contain sufficient perennial vegetation to stabilize it.

Gn = Riverwash, narrow. The streambed (bare ground) occupied by high-volume winter flows (<125 feet wide) supports only sparse, annual vegetation. There is a high probability that the channel will change significantly during a period of high runoff.

Gw = Riverwash, wide. As above, but more than 125 feet wide.

The first nine categories describe the streambanks or the material against which the stream flows during periods of high winter flow. The latter four categories describe the streambed itself. The number of possible combinations of these two types of units is very large, especially where the right and left banks are different units. Since the present study was limited primarily to photo interpretation, only the dominant condition was noted. That is, where different conditions exist on right and left banks of the stream, one was shown on the map.

Conclusions

Table 8 presents a summary of riparian landforms units mapped in the Trout Creek drainage. Miles of each unit are shown by stream and habitat group. Percentages of each landform class are summarized for that portion of the drainage classified. Several basic characteristics of the basin are readily apparent from a brief study of this table. Approximately 25% of the stream miles mapped are Rock and Rubble, of which approximately 50% is in Habitat Group 2 (Ward Creek and central Trout Creek). About 14% consists of terrace units, into which the streams are actively eroding. Almost all of this unit (95%) occurs in Habitat Group 3, on Antelope and Hay Creeks. About 19% of the stream miles consist of narrow and wide riverwash units (Gn and Gw). Over 70% of this is located in the Trout Creek drainage proper and 53% is in Habitat Group 1 (Trout Creek and lower Antelope Creek). Virtually all of the meadow units are mapped on Foley and Martin Creeks. The floodplain units (Fw and Fn), which denote relatively stable stream channels, account for 20% of the classified stream miles, 40% of which occurs in the Trout Creek system. These units make up 30% of Habitat Group 1 in Trout Creek. Fan and Landslide units (Fa and L)

TABLE 8

RIPARIAN LAND FORMS BY STREAM AND HABITAT GROUP (IN MILES)

STREAM	TROUT CREEK			TEN-MILE CR.	WARD CR.	ANTELOPE CR.		INDIAN SPR. CK.	AMITY CR.	OPAL CR.	AUGER CR.	POT-LID CR.	CART-WRIGHT CR.	DUTCH-MAN CR.	BIG-LOG CR.	MAR-TIN CR.	FOLEY CR.	HAY CR.		SUB-TOTAL MILES
HAB-ITAT GRP.	1	2	4	5	2	1	3	7	5	4	4	4	4	4	4	4	4	3	% MILES CLASS.	
R	2.9	3.3	1.2	5.6	6.5	.8	1.7	.4	1.7				.4	.4			1.2	.6	25	26.7
RU	.4	2.5	.2			.2	.6					.6	.4	.4			.8	2.4		8.5
FA	.2																		<1	.6
T	1.3						4.8											14.2	14	20.3
U	.4	.4		2.5				1.6		2.4	1.0	.8	.4	1.6	1.3	.6			9	13.0
C			.8								.4	.4	1.2	1.6	1.2	.8	2.4		6	8.8
L	.3										.2								<1	.5
MD											.1					1.9	3.2		7	5.2
MW																				4.6
FW	.4								.8										20	1.2
FN	8.1	1.2	2.5		.8	1.9	.4	.4	2.7	1.0	1.8	.4		.6	1.0	.6	3.6	.2		27.2
GN	6.3	1.2	3.6						3.3	1.0	.6	.2		.2	.2		.2		18	17.0
GW	7.7					1.6														9.3
SUB-TOTAL MILES	28.0	8.6	8.3	8.3	7.3	4.5	7.5	2.4	8.6	4.4	4.1	2.4	2.4	4.8	3.7	4.9	15.0	17.8		143
% MILES CLASS.	20	6	6	6	5	3	5	2	6	3	3	2	2	3	3	3	10	12		

each account for less than one percent of the total miles and are not a significant portion of any stream or habitat group. The Colluvium and Upland units make up 6 and 9 percent of the classified miles. Both are concentrated in Habitat Group 4 (100% and 62%, respectively).

Classification of riparian landforms appears to be an effective way to rapidly describe and categorize the physical properties of stream systems or portions thereof. Such a standardized method of description facilitates comparison of different streams or different segments of the same stream. Both potential restoration techniques and existing hazards for anadromous fish can be evaluated and described with reference to a given riparian landform unit or even a specific delineation on a particular stream.

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VEGETATION

Introduction

The value of riparian vegetation to fish is well documented. Shading as provided by overhanging streamside trees keeps summer water temperatures within the range of tolerance for fish (Brown 1974), while at the same time preventing harmful anchor ice development during the winter. Insects falling from broadleaf trees are important sources of food during periods of low aquatic insect availability (Mason and MacDonald 1982). In addition, deciduous leaf fall is an important food source of aquatic inects, and provides instream cover for juvenile fish (Hunt 1975). Moreover, overhanging bankside branches and instream root masses protect fish from predators (Meehan et al. 1977).

Riparian vegetation is also an important factor in erosion control. By limiting the movement of sand and silt into streams and preventing slumping and earthflows, bankside vegetation helps to maintain the quality of spawning gravels (Reiser and Bjornn 1979) and slows pool filling. Well-rooted riparian plants decrease the carrying capacity of streams during flooding by decreasing bank sloughing and general erosion caused by high runoff. In addition, well-vegetated banks and slopes promote percolation of precipitation rather than overland flow. This contributes significantly to reducing stream discharge during floods, increasing summer flows and maintaining water quality (Leopold et al. 1964, Glinski 1977, and Winegar 1982).

Habitat Mapping and Field Methodology Development

Because of its importance to stream stability and fish production, vegetation was one of the components studied as part of the Trout Creek project. There were two major objectives of the Phase I vegetation study: to identify the present composition, range, and habitat requirements of the major riparian species and associations in the Trout Creek basin, and to compare this (to the extent possible) with information available on the vegetation of Trout Creek prior to white settlement. The study was divided into three phases: 1) literature and historical information review, 2) air photo analysis and mapping, and 3) development of a field survey methodology. Each of these steps will be described in more detail below.

1) Literature and Historical Information Review. The first phase of the vegetation study involved obtaining an overview of plant communities and species found in the Trout Creek basin and surrounding areas. Contacts were made with the U.S. Forest Service, and Soil Conservation Service, the Oregon Department of Fish and Wildlife and other agencies, with the Oregon Natural Heritage Program of the Nature Conservancy, and with plant ecologists and the University of California and elsewhere. This information was used in developing a vegetation mapping system for the drainage.

The second part of this step was to begin compiling historical information on the vegetation of the Trout Creek watershed. Livestock grazing and agriculture have had a tremendous impact on the native vegetation of the basin. Reconstruction of the pre-settlement flora could be a useful tool in determining both present plant communities as well as potential ones. Hudson's Bay Company Journals, U.S. Township and Range Survey Records, published pioneer journals and other sources of historical information were used in this effort. The results have been incorporated (to the extent possible) in the community classification system, and will be used much more extensively during Phase 2 of the project.

2) Air Photo Interpretation of the Vegetation of Trout Creek and Major Tributaries. Using 1:3,000 color air photographs of the watershed, slope and riparian associations were identified for Trout Creek and each of its major tributaries and mapped on mylar overlays of 1:24,000-scale USGS topographic maps. Each association (or type) was initially identified on the color

photos. Considerable ground truthing took place to verify and futher delineate the types. Changes in aspect from the right to the left slope sometimes resulted in differences in slope associations along a particular reach of the creek. In such cases the predominant slope association was used to characterize the association on the draft overlays.

Within the study area six major slope associations have been identified. They are:

1) sagebrush-grass association
2) juniper-sagebrush-grass association
3) juniper-Ponderosa pine-grass association
4) Ponderosa pine-juniper-grass association
5) upland mixed conifer association
6) wet and dry meadow association

Proceeding from association 1 through 5, each association occupies a progressively higher elevation zone and therefore, requires more precipitation. Wet meadows occur sporadically within the upland mixed conifer association. They are delineated because of their unique species composition, land use, and role they play as water storage areas.

The major riparian associations identified and mapped are:

A) thinleaf alder association
B) willow association
C) thinleaf alder-willow association
D) sedge-rush association
E) annual herbaceous and grass association

Associations A, B, and C are dominated by woody perennial shrubs and trees which often provide important riparian shading. Associations D and E are comprised of herbaceous species. Although providing little riparian shade, the presence of herbaceous vegetaion contributes to bank stability and reduces downstream sediment transport during flood stage. As a result, they have been delineated and mapped as distinct associations.

Extensive grazing by livestock has contributed significantly to the degraded condition of much of the riparian vegetation in the watershed. As a result of this disturbance little continuity exists in the vegetative component to the riparian zone. In order to map a riparian association on the draft overlays, a minimum length of a quarter-mile was required. In areas where associations were interspersed with one another, the predominant association was delineated and mapped on the overlay.

Three land uses predominate in the Trout Creek watershed. Throughout most of the study area cattle grazing occurs. Terraces in the Willlowdale, Ashwood, and Antelope areas are used for the production of alfalfa and hay. Along the upper reaches of Trout Creek and its tributaries conifers are harvested as part of forestry management activities. Since these land users directly affect the riparian and slope associates in the watershed it was decided that delineation of land uses would be done as part of the air photo mapping process. Six land use categories have been classified and mapped; these categores are:

1) agriculture
2) agriculture-range
3) range
4) forestry-range
5) forestry
6) canyon lands

Although "canyon lands" (category 6) are not a specific land use they have been delineated because their topographic structure to a large extent dictates the land use which can occur there. Canyons contain many of the least disturbed, highest quality riparian and slope communities within the study area.

A three digit code has been used to identify the vegetation mapping units delineated on the draft overlays. The first digit (number 1-6) signifies the slope association, the second digit (letter A-E) signifies the riparian association, and the third digit number (number 1-6) signifies the land use category. By using the legend included in Appendix C, the slope association, riparian association, and land use can readily be interpreted for each mapping unit. For example, Code 2B2 signifies a slope association of juniper-sagebrush-grass, a riparian association of willow, and a land use of agriculture and range.

3) Development of Field Methodology. In order to simplify the vegetative sampling process and keep it consistent, a field data collection form was developed (Figure 8). Each stream reach is divided into slopes, banks and stream. "Slopes" are defined as those areas above the seasonally wetted zone. In the field this zone is delineated by the absence of recent high water marks and aboreal phreatophytes. "Banks" include the areas between high and low water marks, while areas continuously inundated are designed as "stream" on the form.

During Phase 2 of the Trout Creek Project, sampling sites will be randomly selected from each representative vegetation/land-use type as delineated and mapped in Phase 1. Any vegetation or land-use types of significance that were not noted during the Phase 1 will also be sampled.

Three transects will be laid out perpendicular to the stream at each sampling point. The point-quarter method will be used to sample trees on forested slopes. Line intercept transects will be used on trees in non-forested slopes and streambanks on herbs and grasses on banks. Herbaceous vegetation on forested and non-forested slopes will be estimated as a "percent cover" figure. This specific combination of sampling methods was arrived at through trial and error in the field.

The information that can be calculated from these data include total density, density of individual species, total canopy coverage, coverage of individual species, species importance values and species composition. With this information it will be possible to further differentiate the vegetative associations, identify the relative contribution of different riparian species and associations to stream and slope coverage, and estimate potential vegetation for the different geomorphic/altitudinal zones under less disturbed conditions. Areas of slope instability

Vegetation Field Data Collection Form
Figure 8

RIPARIAN HABITAT EVALUATION

Stream | Habitat Type
Location | Surveyor
Air Photo # | Date
Transect # | Photo #
Landuse | Elevation

Photo Description:

Comments:

Riparian Cross Section:

RIGHT SIDE(FACING DOWNSTREAM)

SLOPE   ASPECT   W=   TRANSECT #

POINT#	QUADRANT#	SPECIES	DBH	AREA	PT TO PL DIS
1	1				
	2				
2	1				
	2				
	3				
	4				
3	1				
	2				

TREES(ARID ONLY)

Sp.1   Sp.2   Sp.3   Sp.4

SHRUBS

Sp.1   Sp.2   Sp.3   Sp.4

GRASS/HERB COVER

0-5%   5-20%   20-40%   40-60%   60-80%   80-100%

BANK

TREES

W=

Sp.1   Sp.2   Sp.3   Sp.4

SHRUBS

Sp.1   Sp.2   Sp.3   Sp.4

GRASS/HERB SPECIES

LEFT SIDE(FACING DOWNSTREAM)

SLOPE % ASPECT W= TRANSECT#

POINT#	QUADRANT#	SPECIES	DBH	AREA	PT TO PL DIST
1	1				
	2				
2	1				
	2				
	3				
	4				
3	1				
	2				

TREES(ARID ONLY)

Sp.1 Sp.2 Sp.3 Sp.4

SHRUBS

Sp.1 Sp.2 Sp.3 Sp.4

GRASS/HERB COVER

0-5% 5-20% 20-40% 40-60% 60-80% 80-100%

BANK

TREES W=

Sp.1 Sp.2 Sp.3 Sp.4

SHRUBS

Sp.1 Sp.2 Sp.3 Sp.4

GRASS/HERB SPECIES

Grass Sp.1 Sp.2 Sp.3 Sp.4 Sp.5

Figure 8 cont.

ɔue to vegetation removal) should become evident. Moreover, ensitive, threatened or endangered plant taxa in the watershed may be identified.

Riparian plants exist under different shade conditions, size of substrate, and period of soil saturation by water. These factors in turn are determined by the parent material, the intensity and duration of annual flooding, and the change in stream morphology over time (Teversham and Slaymaker 1976, Strahen 1981). In order to identify some of these habitat requirements for significant riparian species, the following information is included in the field form: altitude, relative elevation above mean low water, substrate size and geomorphic feature (e.g. cut bank or point bar). In addition, age structures for some species will be constructed using tree ring data. This will assist in understanding the reproductive status of significant species.

The presence or absence of plants in many areas will obviously reflect the relative intensity of livestock grazing or foresty activity. Nevertheless, preliminary work indicates that some of the major taxa i.e. thinleaf alder, black cottonwood and five species of willow) occupy reasonably distinct habitats. This information - along with the identification of potential sites for willow cuttings - will help determine which species should be planted where during the prescription process in Phase 2 of the project. Photos will be taken at each restoration site (along with a written description) so it will be possible to judge the relative success of different vegetation prescriptions over time.

Conclusions

The air photo interpretation and ground reconnaissance indicate that undisturbed riparian communities are almost non-existent in the Trout Creek basin. The most intact streamside forests are thinleaf alder associations in Ward Creek and Degner Canyon -- both bedrock canyons.

Thinleaf alder/willow associations are best developed in agricultural areas that do not exhibit extensive livestock grazing. Likewise, the most intact willow associations are present in relatively ungrazed areas.

The sedge-rush association is uncommon in the watershed. It is indicative of a perennially wetted zone that is not severely grazed. This streamside association will recover quickly when livestock grazing pressure is reduced.

The annual herbaceous and grass association is indicative of severe livestock grazing, and is often associated with logging and other land use practices. It often occurs in open flood plain areas and is dominated by exotic, weedy species.

Cattle grazing appears to be a significant limiting factor for riparian vegetation. Preferential selection of tender willow, alder and cottonwood shoots has probably eliminated these plants from many areas in the watershed. Logging operations have mixed impacts. When combined with intensive grazing, logged areas are as degraded as any in the watershed. Several logged areas in the upper Trout Creek drainage, however, are covered by dense thinleaf alder stands where timber removal has been extensive but livestock grazing has been limited.

The eventual vegetative prescriptions will largely entail modifications of present land uses. Dense thinleaf alder stands and some willow populations are sufficiently intact that little or no management will be recommended. Restoring riparian vegetation to arroyo cuts, which are common in the drainage, will be difficult but appears feasible. Based on restoration projects in nearby areas, recovery of riparian vegetation in the Trout Creek basin could occur relatively quickly. Additional field work will be necessary to fully document the existing riparian vegetation in the watershed and provide adequate data for Phase 2 restoration planning.

WILDLIFE

Introduction

The Trout Creek drainage supports a diverse wildlife community, as can be expected from the variety of habitat types found in the watershed. Wildlife found in Trout Creek varies from species dependent on dense, old-growth coniferous forest (such as goshawk and northern flying squirrel) to those requiring dry, open sagebrush grasslands, such as vesper sparrow and pronghorn antelope. It is estimated that 295 wildldife species (approximately 60% of the total number of species found in Oregon) are found in the Trout Creek basin. Of these, 25 are classified as game species or furbearers; the rest are considered non-game species.

Air Photo Analysis and Habitat Mapping

One objective of the Trout Creek study was to develop, field verify, and then map a wildlife habitat classification system for the Trout Creek watershed. This task was accomplished in three steps: 1) Literature and agency information review, 2) Drafting and field checking a wildlife habitat classification system, and 3) Using air photographs to map the drainage in the final habitat classification system. Each step will be described briefly.

1) Literature and Agency Information Review. The first step of the wildlife habitat classification involved a review of existing wildlife literature for the area and coordination with wildlife and land management agencies. Contact was made with the Prineville and Bend offices of the Oregon Department of Fish and Wildlife, the Ochoco National Forest, the Bureau of Land Management, and non-agency biologists. A comprehensive wildlife species list for the drainage and surrounding areas was compiled using agency lists, environmental statements, and observations made by NBC staff and other biologists. Existing wildlife and

plant community classification systems for central and eastern Oregon were reviewed, including those developed by Thomas (1979), Hall (1974), the Burea of Land Management (Brothers Grazing EIS, 1982), the Soil Conservation Service (Green 1975), the U.S. Forest Service (1978) and the Bureau of Land Management (Trout Creek Survey, 1980). A separate, concurrent effort was undertaken to map special wildlife habitat features in the drainage, such as mule deer and elk winter range and raptor nests.

2) Drafting and Field Checking a Wildlife Habitat Classification System. A draft wildlife habitat classification system for Trout Creek was developed after studying the wildlife species known or expected in the watershed (and the habitats they required for reproduction, feeding, and other key parts of their life cycles) and existing wildlife classification systems for nearby areas. This draft system was field checked both on the ground and from the air (in a flight over the drainage), and checked against representative air photos of the watershed. This led to changes (for example, meadow and marsh communties were collapsed into one habitat type because they were indistinguishable in air photos) and the system was refined into its present form.

3) Mapping the Watershed Using Air Photographs. The final wildlife habitat classification system was mapped onto mylar overlays of 1:24,000 USGS topographic maps, using information from 1:3,000 scale color air photos. The following wildlife habitat types were mapped:

Upland Habitat Types: High Desert

Habitat 101: Sagebrush Steppe

This habitat type consists primarily of desert shrublands dominated by big sagebrush, rabbitbrush, bitterbrush, and other shrubs, bluebunch wheatgrass, Idaho fescue, and other grasses, and forbs. It is an open landscape, with few nesting sites for large raptors and little cover for deer and antelope (although it can have significant winter forage value). Representative wildlife species of this habitat type include marsh hawk, pronghorn antelope, vesper sparrow, sagebrush lizard, and sage grouse.

Habitat 102: Juniper-Sagebrush Woodland

This habitat is very similar to the sagebrush steppe community, except that western juniper is present and adds an overstory layer to the habitat type. In addition to the sagebrush steppe wildlife species listed above, a new set of wildlife species - those desert species requiring a tree canopy for feeding, reproduction, or some other key element of their life cycle - are added. Representative wildlife species of this habitat type include Brewer's sparrow, eastern kingbird, loggerhead shrike, and pinyon mouse.

Habitat 103: Cliffs/Talus/Caves

The cliffs/talus habitat type includes steep rocky terrain, large and small boulder and talus fields, caves, and rimrock, without a specific source of water within the habitat. This habitat type is often used as a reproduction area, with feeding for its residents taking place in other communities. Wildlife species of this habitat type include prairie falcon, golden eagle, bobcat, bushy-tailed woodrat, side-blotched lizard, and cliff swallow.

Upland Habitat Types: Coniferous Forest

Habitat Type 104: Ponderosa Pine Forest

The Ponderosa pine forest is a habitat type dominated by an overstory of ponderosa pine, with an understory that often includes bluebunch wheatgrass, sagebrush, juniper, snowberry or other shrubs, or other conifers. It is generally an open, parkland type of habitat, with a lush understory. Wildlife species which prefer this habitat type include varied thrush, pygmy nuthatch, flammulated owl, shorttail weasel, and yellow-pine chipmunk.

Habitat Type 105: Mixed Conifer Forest

This habitat type consists of generally dense forest dominated by a mixture of ponderosa pine, white fir, larch, Douglas fir, and other conifer species. The mixed conifer forest is found only in the upper reaches of the Trout Creek drainage, and is key summer and winter range for Rocky Mountain elk. Wildlife species characteristic of this habitat include elk, spotted skunk, northern three-toed woodpecker, northern flying squirrel, goshawk, and yellow-rumped warbler.

Lowland Habitat Types: Riparian Habitats

Habitat Type 106: Deciduous Riparian Woodland

Deciduous riparian woodland is by far the richest wildlife habitat type in the Trout Creek drainage, in terms of species number and abundance; it is also the rarest. This habitat consists of streamside communities dominated by alder, willow, dogwood, aspen, and other deciduous trees or shrubs. Wildlife species that prefer this habitat type include belted kingfisher, river otter, water vole, red-eyed vireo, American redstart, yellow-breasted chat, and orange-crowned warbler.

Habitat Type 107: Marsh/Meadow

This habitat type consists of wet communities dominated by sedges, rushes, and grasses. Because of intensive grazing pressure on meadow and marsh communities in virtually the entire watershed (which has made them indistinguishable from the air) and lack of opportunity to field check areas, these two communities have been combined into one habitat type. Wildlife species found in this habitat include American avocet, common snipe, killdeer, willet, vagrant shrew, and long-tailed vole.

Habitat Type 108: Ponds/Reservoirs

This habitat consists of open, still water and the rim of meadow and marshland surrounding it. Generally, the larger the pond the greater the abundance and diversity of wildlife species.

Wildlife species in the Trout Creek drainage preferring this habitat include Canada goose, green-winged teal, gadwall, western grebe, and northern shoveller.

Other Habitat Types

Habitat Type 109: Agricultural Cropland

Agricultural cropland is made up of field planted to annual or perrennial crops such as alfalfa, sweet clover, wheat, or other crops. This habitat type generally has low value for reproducing wildlife because of too-frequent disturbance during critical periods; it can have moderate to high short-term foraging value, especially during winter and spring. Year-round residents are confined to a few, usually exotic, species such as starling and English sparrow. This habitat is used as a hunting/feeding area by kestrel, marsh hawk, western meadowlark, horned lark, and other species.

Conclusions

Although air photo analysis is obviously a limited means of assessing wildlife habitat, it is a rapid way of getting an overview of a large area, and is useful in showing overall habitat relationships. The air photo analyis of wildlife habitats in the Trout Creek drainage has pointed out several factors which are important to wildlife in the watershed:

1) There is effectively no deciduous forest at present in the Trout Creek watershed. According to the literature, cottonwood and aspen forests are the richest wildlife habitats (in terms of number of wildlife species and overall wildlife abundance) in the Central Oregon mountains and high desert; yet there are no stands of either aspen or cottonwood visible in the air photographs. In terms of wildlife this deserves further study and reintroduction of these habitat types should be a serious consideration in any stream restoration projects.

2) The best-quality, least disturbed riparian areas are located in canyons. The larger, deeper, and more remote the canyon, the more extensive and mature the riparian woodland is.

3) Preliminary observation indicates that, from a wildlife perspective, marsh and meadow communities have effectively been reduced into one habitat type through persistent grazing pressure. This would most likely benefit wildlife species preferring moist, open areas (such as killdeer) while harming those dependent on the cover a healthy marsh provides (such as soras, rails, or bitterns).

4) The floodplain is rarely homogenous in terms of wildlife habitat; more detailed, smaller-scale site-specific mapping will be necessary to clearly delineate habitats for any rehabilitation work.

CONCLUSIONS

The multi-disciplinary approach inherent in this project tends to convey a somewhat disjointed picture. In an attempt to integrate the data from the several disciplines, the conclusions have been organized around the Habitat Groups introduced in the Fisheries Section (Figure 9).

Habitat Group I includes 30 miles of lower and middle Trout Creek and 4.5 miles at the lower end of Antelope Creek. Cropland, most of it irrigated, is the most prevalent land use adjacent to the stream in this unit. Approximatley 50% of this habitat group has the most unstable riparian land form class - riverwash. In fact 60% of the riverwash mapped occurred in this group.

Since the bedload in the riverwash class consists primarily of gravel, a large portion of the best potential spawning habitat probably occurs in this group. However, this riparian landform class is also the most unstable, in terms of lateral migration and deposition. Thus the high spawning potential afforded by abundant well sorted gravel is largely offset by unstable streambed conditions during peak winter flows.

A large portion of the riparian agricultural land in the Trout Creek basin also occurs in Habital Group I, therefore most of the economic losses due to bank erosion and sediment deposition are felt here.

Low pool frequency and high concentration agricultural withdrawal combine to keep the rearing capacity of the group far below its potential.

Habitat Group 2 includes only 16 miles of stream on Ward Creek and the Degner Canyon portion of Trout Creek. However, this group contains a large portion of the least disturbed riparian vegetaion remaining in the basin. Grazing is the predominant land use. There is no intensive agriculture or water withdrawal taking place in this area. Over three quarters of stream miles in this group are bordered by rock and talus, or·rubble, which results in a relatevly stable stream channel. Large pools are more common than in all other habitat groups due to scour effects at rock

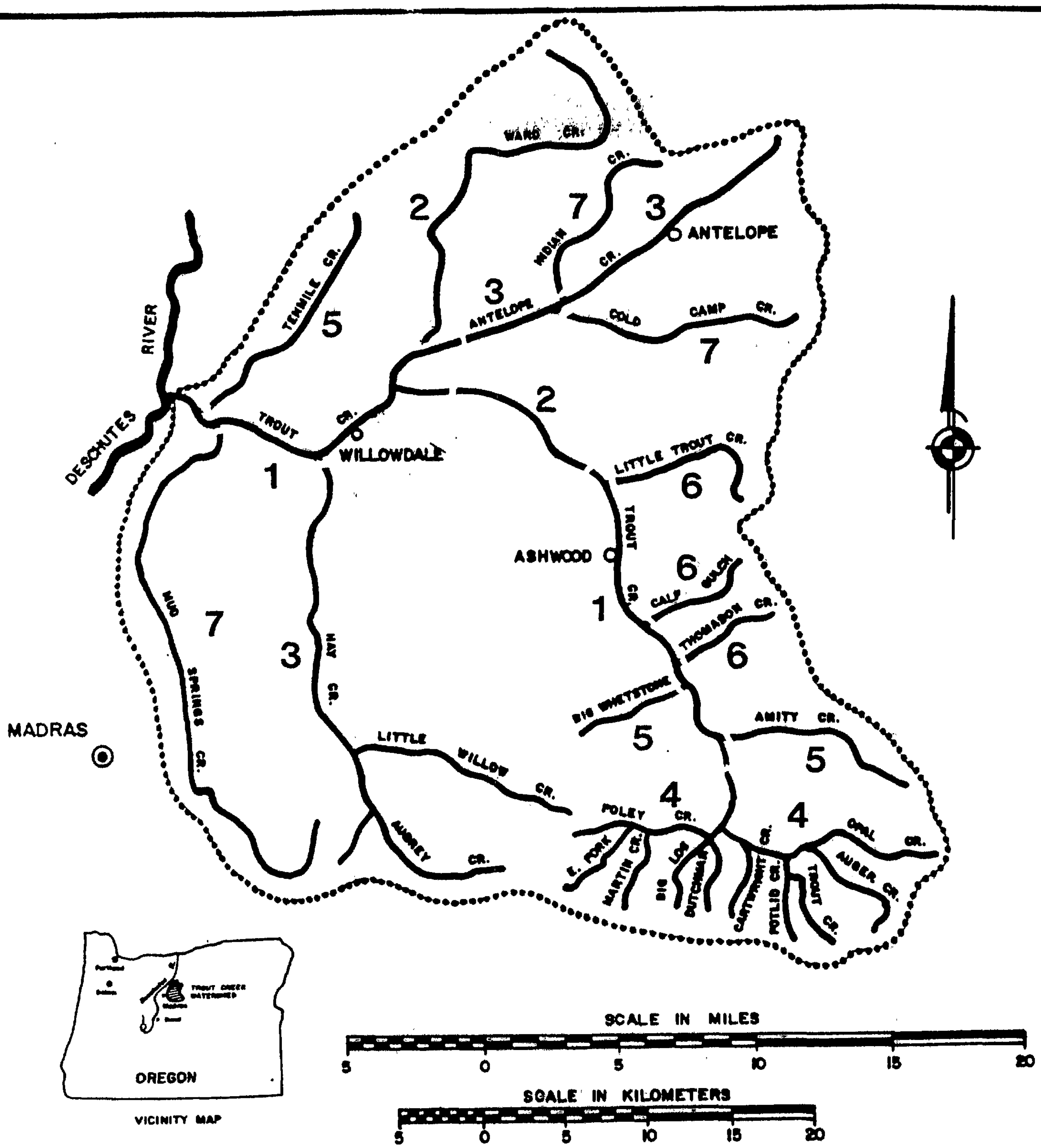

Figure 9. HABITAT GROUPS MAP

TROUT CREEK WATERSHED

outcrops. High pool and shade frequency combine to make this habitat group very valuable as a rearing environment. Somewhat more stable streambed conditions render the spawning areas more effective. Because tree-size deciduous riparian vegetation is in close proximity with cliffs and talus slopes throughout this group, it affords perhaps the most diverse wildlife habitat in the basin. Several similarly diverse canyons occur on other streams in the drainage, but are too small to be considered at this habitat group level.

Habitat Group 3 includes 25 miles of stream on Hay and upper Antelope Creeks. Irrigated cropland is the predominant land use within this group. Essentially all the ripairan/agriculture in the basin occurs in habitat groups 1 and 3. As a result of intensive agriculture, several miles of stream have been completely channelized and rerouted in both of these drainages. Irrigation allottments exceed average discharge. Wildlife habitat is perhaps the least diverse of any habitat group, due to cultural modifications. Riparian landform T (terrace) accounts for 75% of this group. This unit consists of deep sand and silt deposits. Therefore, gravel and cobbles are not abundant in streambeds, and down-cutting is common. Gullies 20 or more feet in depth cause waterfalls which presently block upstream migrating adult fish. Due to low base flows, seasonally high water temperatures and severely limited spawning conditions, this habitat group is presently given a very low priority for riparian habitat restoration.

Habitat Group 4 is by far the largest single group, accounting for 50 miles or 35% of the stream miles classified. This group occupies the southeast corner of the basin between elevations of 3,000 and 4,600 feet. Precipitation averages 20 to 25 inches annually, and about one third falls as snow. The majority of this area receives at least moderate shade from coniferous trees, even where riparian hardwoods are severely reduced in number. Except for the lowest 3 or 4 miles, on the Trout Creek portion, stream beds in this group are relatively stable. Deciduous riparian vegetation is poorly developed due to grazing and/or logging except on the Ochoco National Forest portion of Auger Creek. On this stream, 2 or 3 years of grazing control has resulted in a dramatic recovery of riparian hardwoods. Wildlife habitat in this group is particularly valuble for deer and elk. Prolonged summer flows and low water temperatures render all the streams in this group important for both spawning and rearing. Small volume and pool area limit the production potential of these rather small streams, however.

Habitat Group 5 includes 19 miles of stream on Ten Mile and Amity Creeks, approximately 1/8 of the classified portion of the drainage. These watersheds are steep and have relatively unstable streambeds (40% Riverwash, GN). Riparian vegetation is very poorly represented, due to heavy grazing pressure. Wildlife habitat is lacking in diversity primarily because of the absence of suitable riparian hardwoods. Low, late summer flows, lack of shade and pools, severely limit rearing capacity, but considerable spawning potential exists in these drainages.

Habitat Group 6 includes approximately 15 miles of channel in Little Trout, Tub Springs, Thompson and Gooseberry Creeks. All are east-west trending tributaries to Trout Creek, between Degner Canyon and Amity Creek. Late summer and early fall flows are intermittent or nonexistent. Channel widths indicate high peak season flows, however. This group therefore has significant potential for spawning but not for rearing. Land use is predominantly as range, and wildlife habitat diversity is limited by complete absence of riparian hardwoods, due to grazing.

Habitat Group 7 is a variety of streams, in both the upper and lower Trout Creek basin. Mud Springs Creek is approximately 17 miles long, and enters Trout Creek about 3 miles above its mouth. Falls in the lower reaches prevent upstream migrants from entering this system. The entire flow consists of returned irrigation water. Therefore the main significance of this tributary is as a source of cool water during periods of low flow and high temperature. Agriculture is the most important land use along the lower portion of this stream and wildlife habitat is therefore limited. The remaining streams in this group, Indian

Camp, and Grub Hollow Creeks are all tributary to upper Antelope Creek. They enter above severely altered reaches of the main stream. Range is the principal land use and riparian vegetaion is completely absent. These tributaries are not presently important for steelhead spawning, but do contribute cool water to upper Antelope Creek during late summer and early fall.

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APPENDICES

APPENDIX A

CONTACTS

Oregon Department of Fish and Wildlife

1. Bob Lindsay	Fish Biologist	Madras, OR	Nov. 8
2. Ed Schwartz	Fish Biologist	Prineville,OR	
3. Errol Claire	Fish Biologist	John Day, OR	Oct. 21
4. Brad Smith	Fish Biologist	John Day, OR	Oct. 21
5. Harold Winnegar	Consultant, Ret.	Prineville, OR	
6. Jim Newton	Fish Biologist	The Dalles, OR	
7. Harlan Scott	Wildlife Bio.	Prineville, OR	Oct. 10,13; Nov. 2
8. Del Webb	Wildlife Bio.	Bend, OR	Nov. 2
9. Rich Berry	Fish Biologist	Portland, OR	
10. Phil Howell	Fish Biologist	Corvallis, OR	Oct. 7
11. Larry Korn	Fish Biologist	Portland, OR	June, Oct 18
12. Len Matisse	Regional Director	Bend, OR	Sept, Oct 1983
13. Harry Wagner	Fisheries Director	Portland, OR	June, 1983

United States Forest Service

1. Marion Tryon	Wildlife/Fish Bio. Ochoco N.F.	Prineville, OR	Sept 23; Oct. 20
2. Brady Green	Fish Biologist Malheur N.F.	John Day, OR	
3. Bruce Anderson	Hydrologist Ochoco N.F.	Prineville, OR	Oct. 1983
4. Bud Kovalchik	Botanist Deschutes N.F.	Bend, OR	Sept. 26
5. Bill Hopkins	Botanist Deschutes N.F.	Bend, OR	Oct. 11

Soil Conservation Service

1. Jim Cornwell	Dist. Conservationist	Madras, OR
2. Larry Bright	State Engineer	Madras, OR
3. Duane Wilson	Regional Conservationist	Madras, OR
4. Dick Olson	Regional Engineer	Madras, OR

Public Works

1. Robert Main	Watermaster	Bend, OR	Oct. 24

United States Bureau of Land Management

1. John Heffner	Wildlife Bio.	Prineville, OR	Oct. 20

University of California, Berkeley

1. Jan Strahan	Forest Ecologist	Berkeley, CA	Oct. 4

The Nature Conservancy

1. Curt Soper	Data Base Coordinator	Portland, OR	Oct. 24

Jefferson County Soil and Water Conservation District

1. Glenn Simmons	Chairmon	Madras, OR	Frequently
2. Andy Morrow	Board Member	Madras, OR	Oct. 1983
3. Dean Ditmore	Board Member	Madras, OR	Sept/Oct. 1983
4. Biff Johnson	Board Member	Madras, OR	Sept/Oct. 1983

Division of State Lands

1. Ken Bierly	Staff	Salem, OR	Nov. 1983
2. Earl Johnson	Staff	Salem, OR	Nov. 1983

Division of Water Resources

1. Ben Scales	Hydrologist	Salem, OR	Oct. 1983

Private Ranchers and Landowners

During the period Sept. 1 to Nov. 17, 1983 a minimum of twenty five landowners were contacted. Some of the contacts were by phone while others involved personal contacts, including meetings in the field.

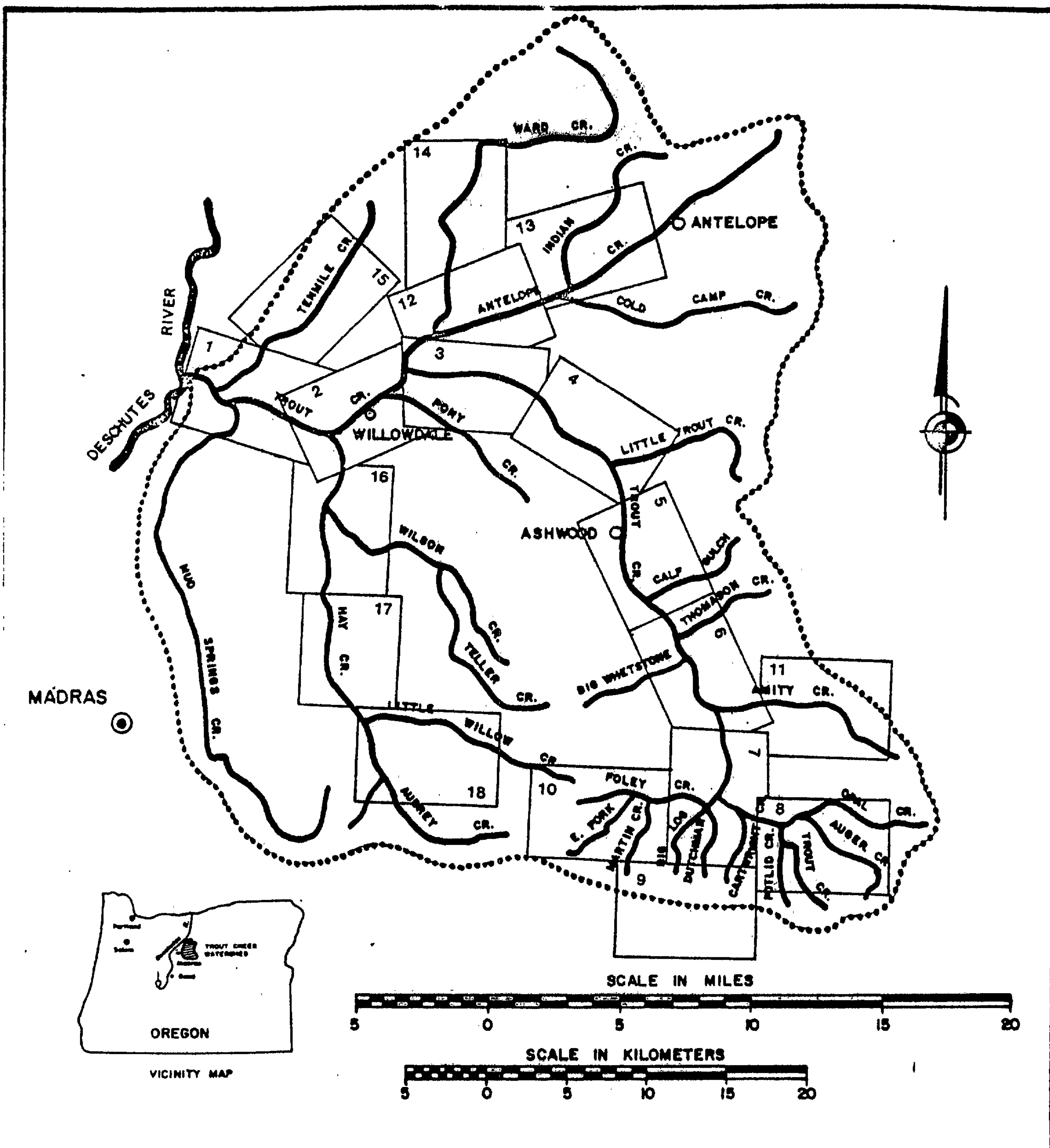


Figure C1. INDEX TO MAP OVERLAYS
APPENDIX C

TROUT CREEK WATERSHED

APPENDIX C

VEGETATION MAPPING UNITS

Symbol	Name
1A2	Sagebrush-grass, Thinleaf alder, Agriculture-range
1A6	Sagebrush-grass, Thinleaf alder, Canyon
1B1	Sagebrush-grass, Willow, Agriculture
1B2	Sagebrush-grass, Willow, Agriculture-range
1B3	Sagebrush-grass, Willow, Range
1C6	Sagebrush-grass, Thinleaf alder-willow, Canyon
1D1	Sagebrush-grass, Sedge-rush, Agriculture
1D6	Sagebrush-grass, Sedge-rush, Canyon
1E1	Sagebrush-grass, Annual herbs & grass, Agriculture
1E2	Sagebrush-grass, Annual herbs & grass, Agriculture-range
1E3	Sagebrush-grass, Annual herbs & grass, Range
2A6	Juniper-sagebrush, Thinleaf willow, Canyon
2B1	Juniper-sagebrush, Willow, Agriculture
2B2	Juniper-sagebrush, Willow, Agriculture-range
2B3	Juniper-sagebrush, Willow, Range
2B6	Juniper-sagebrush, Willow, Canyon
2C1	Juniper-sagebrush, Thinleaf willow-alder, Agriculture
2C2	Juniper-sagebrush, Thinleaf willow-alder, Agriculture-range
2D2	Juniper-sagebrush, Sedge-rush, Agriculture-range
2D6	Juniper-sagebrush, Sedge-rush, Canyon
2E1	Juniper-sagebrush, Annual herbs & grass, Agriculture
2E2	Juniper-sagebrush, Annual herbs & grass, Agriculture-range
2E3	Juniper-sagebrush, Annual herbs & grass, Range
2E6	Juniper-sagebrush, Annual herbs & grass, Canyon
3B4	Juniper-Ponderosa pine-grass, Willow, Forestry-range
3C3	Juniper-Ponderosa pine-grass, Thinleaf willow-alder, Range
3D6	Juniper-Ponderosa pine-grass, Sedge-rush, Canyon
3E6	Juniper-Ponderosa pine-grass, Annual herbs & grass, Canyon
4A4	Ponderosa pine-juniper-grass, Thinleaf alder, Forestry-range
4B4	Ponderosa pine-juniper-grass, Willow, Forestry-range
4C4	Ponderosa pine-juniper-grass, Thinleaf alder-willow, Forestry-ra
4E4	Ponderosa pine-juniper-grass, Annual herbs & grass, Forestry-ran
5A4	Upland mixed conifer, Thinleaf alder, Forestry-range
5B6	Upland mixed conifer, Willow, canyon
5C4	Upland mixed conifer, Thinleaf alder-willow, Forestry-range
5E4	Upland mixed conifer, Annual herbs & grass, Forestry-range
5E5	Upland mixed conifer, Annual herbs & grass, Forestry
5E6	Upland mixed conifer, Annual herbs & grass, Canyon
6B3	Wet and dry meadow, Willow, Range
6E3	Wet and dry meadow, Annual herbs & grass, Range

APPENDIX C

KEY FOR RESOURCE FEATURES

Fisheries

Habitat Group 1
Habitat Group 2
Habitat Group 3
Habitat Group 4
Habitat Group 5
Habitat Group 6
Habitat Group 7

Waterfall
Beaver Impoundment
Water Diversion
Road Encroachment
Bank Cutting
Irrigation Ditch
Reservoir

Geomorphology
(symbols in brown)

R - Rock
Ru - Rubble
Fa - Fan
T - Terrace
U - Upland
C - Colluvium

Md - Meadow, dry
Mw - Meadow, wet
Fn - Floodplain, narrow
Fw - Floodplain, wide
Gn - Riverwash, narrow
Gw - Riverwash, wide

Vegetation
(symbols in green)

Slope Associations

1. Sagebrush-grass
2. Juniper-sagebrush-grass
3. Juniper-P. pine-grass
4. P. pine-Juniper-grass
5. Upland mixed conifer
6. Wet and dry meadow

Riparian Associations

A. Thinleaf alder
B. Willow
C. Thinleaf alder-willow
D. Sedge-rush
E. Annual herbaceous veg.

Land Use

1. Agriculture
2. Agriculture-Range
3. Range
4. Forestry-range
5. Forestry
6. Canyon

Wildlife

101 - Sagebrush steppe
102 - Juniper-sagebrush Woodland
103 - Cliffs/Talus/Caves
104 - Ponderosa Pine Forest
105 - Mixed Conifer Forest-EWR,ESR
106 - Deciduous Riparian Woodland-DWR
107 - Marsh/Meadow
108 - Pond/Reservoir
109 - Agricultural Cropland

Note: DWR - Deer Winter Range
EWR - Elk Winter Range
ESR - Elk Summer Range

APPENDIX D

LAND OWNERSHIP KEY

1. Ochs, Ronald
2. Ditmore, Dean & Audrey
3. Austin Co. Roth, David & Janette
4. Pampllin, R.B.
5. Bolter, Co Johnson, Chas. D & Betty
6. Priday, J. Warner
7. Bauer, Floyd
8. Horigan Co. Putman or Reuter, Wm. & Mary
9. Oregon Fir Co Vaeretti, Howard J. & Christina
10. U.S.A.
11. Richardson Recreation Ranch
12. Fuston, Chester
13. Bates, Earl & Barbara
14. Vibbert, Ronald Co., Alps, John
15. Fuston Co., Walker, Bill R.
16. Lawson, Herbert
17. Moon, George
18. Marybrook Corp. (Haycreek Ranch)
19. Trolan, Selma
20. Haufle, Jean & Rhoades, Clem
21. Nartz, Joe
22. Borthwick, E.O.
23. Johnson, Frances et al., Co. Bedertha, Kenneth Co. Hodges et al.
24. Forman, Pauline M. & Chas. W.
25. Forman Co., Kaseberg, Darrell R. & Donna L.
26. Forman, Roy
27. McNamee Ranches
28. Nartz, Willis
29. Thornton, L.A. Co., Dettwyler, Fred & Barbara
30. Hale, Aaron Co., Nartz, James L.
31. Friend, Byron & Luella
32. Swanson, Ruth
33. Wheeler, F.A. Jr. & H.A.
34. McDonald, Thomas
35. Grater Co., Nartz, James L. & Lynn
36. Finnell, Robert
37. Thornton Co., Dettwyler, Fred & Barbara
38. Marston, Bertha A.
39. Rhodes, Clairibel
40. Bender, Bryce K.
41. Cram, Jack H. & Alice
42. Chidvalis, Rajneesh Meditation Center
43. McKay, Alexander
44. Palmer Co. Signs, Donald & Marjorie M.
45. Burkhart, Lena
46. Soloman, Forrest et al.
47. Beeler Development Co.
48. Keegan, Charlotte & Chas.
49. Shelfer, John J.
50. Crowley, Raymond G.
51. Wharton, Fenton R. & Hazel
52. Whatton, Fenton R. & Hazel
53. Lowther, Willard V.
54. Oreco Enterprises Inc.
55. Mueller, J.D.
56. Sauther, E. Camille & Glenn
57. Bussard Co, BaiLey, Wayne D.
58. Ramsey, James
59. Regnier, A.D. & Fannie
60. Spring Mtn. Ranches Inc.
61. Evick, Nellie
62. Evice, Morris & Margaret
63. Ramsey, James
64. Diamond International
65. Moon Co., Bates, Earl & Barbara
66. O'mera, Phillip G.
67. Lyttle, Jessie & DeLude, Wm. & Buck, Betty
68. Austin, Joe & Barbara L.
69. Bolter Co., Gay, Roger L. & Viole
70. Vibbert, R. Hugh & Joyce, and H. Bryce & Linda
71. Fuston, Chester Co., Otter, Josep
72. Fitzsimmons Co., Roth, David D. & Jeanette
73. Fenwick, Edwin T. Co., Roth, David D. & Jeanette
74. Durette, Wm. R.
75. Vibbert, Herbert A. & Dorie C.
76. McConaghy, John A. & JoAnn
77. Knechtges, Donald & Jacqueline
78. Gregson, Jack & Gillette, Ray D.
79. Easter, Larry J. & Christina M.
80. Qualle Co., Dodson, Jeanne
81. Johnson, Arthur
82. Young, Harry A.
83. Smallwood, James H. & Judy A.
84. Metteer, Barbara M.
85. Barry, Emmett & Eloise
86. Stine, Paul H. & Eunice, and Ottenbacher, Judith K.
87. Devine, Wm. & Vicky
88. Snyder, Perry A. Co. Jasa, A.J. & Grace

89. Townsend, Earl & Elva L.
90. Miller, Jack & Feturah G.
91. Evans Co., McDonald, Thomas & Marian, Co. C.O.P.C.A.
92. Evans, Rube & Sarie Jones
93. Kaser, John & Robert
94. Wheeler, F.A. Jr., & H.A.
95. McDonald Co., Diamond Inter.
96. Pine Products
97. Norton, Parr & Mar (or Mary N.)
98. Norton Co., Diamond Inter.
99. Wharton, Hazel F.
100. Soloman, Forrest
101. Richardson Co., Evans, Rube W. & Saraie Jones Evans
102. Johnson Co., Hodges, John; Kilgore Vernon D.; McKinnon, Michael D.
103. McDonald, Beth
104. Nartz, James & Lynn
105. Miller, Ira Dean Jr.
106. Keegan, Charles J & Charlotte B.
107. Shaniko Cattle Co., Inc.
108. Priday Brothers Inc.
109. Priday, John W. Co., Priday, John Annan
110. Borthwick, E.O. & Lottie L.
111. Taylor Cattle Co., Smith, Earl A. & G. Ann
112. Cooke, Frederick C. & Rice, Frances C., Co. Swan, George W. & Loretta C.
113. Van Gilder, Glenn & Gertrude, Co. Kauer, Robert R. & Darlene A.
114. Folmsbee, Mary Lyon
115. The Nature Conservancy
116. Maxwell, Arthur C. & Hazel
117. City of Antelope
118. Stubbs, Robert Lee & Karen I.
119. Johnson, Chas. D. 7 Betty J.
120. State Highway Commission
121. Priday, John W. & Patricia
122. Hastings, John r. & Fiala, Bonita C.
123. Hastings, John R.
124. Hastings, John R. & Fiala, Bonita C., Co Forman, Phyllis Ann
125. Lucas, Roberta E.
126. Smallwood, Lester R. & Ellen M.
127. Metteer, Ronald E.
128. Metteer, Ronald E. & Ruth A.
129. Kimsey, Duff & Mirtle J. Co Smallwood, Lester R. & Ellen N.
130. Gomes, Donald C. & Marjorie M.
131. Brown, Clarence E. & Barbara Co. Kauer, Robert R. & Darlene Ann
132. Perkins, James & Shirley Ann

APPENDIX E

STREAM SURVEY METHODOLOGY

Sections will be preselected by measuring 1/4 or 1/2 mile distances from the mouth of each stream on topographic maps. The following procedures will be used to obtain the data recorded on the stream survey form:

Temperature: Will be taken using a hand-held thermometer (F). Air and water temperatures will be taken and time and date recorded.

Stream Flow: Will be estimated using the stick-float method to obtain velocity readings. Widths and depths will be measured and stream flow (CFS) calculated.

Section Length: Distance of stream section will be measured from aerial photos and USGS maps.

Pool/Riffle Ratio: Will be estimated by surveyor for each section walked. Scale to be used is on a 1 to 10 basis.

Turbidity: Will be classified into three categories;
Clear--bottom visible in pools and riffles
Murky--bottom visible but features indistinct
Muddy--bottom not visible

Gradient (%): Will be measured with a clinometer by sighting upstream and downstream from water level.

Stream Shading (%): Includes all types of shading from riparian and non-riparian sources, including banks and slopes, as percent of stream shaded between 11:00 am and 3:00 pm.

Riparian Shading (%): Includes percent of stream shaded exclusively by riparian vegetation between 11:00 am and 3:00 pm.

Riparian Ground Cover (%): Includes percent of ground covered. Length of right and left banks, considered separately with riparian ground cover.

Ripairan Cover Composition (%): Percent of total riparian ground cover found on each bank broken down into three categories-grass, shrubs and trees. Total equals 100%.

Riparian Grazing Activity: Observed grazing activity in riparian zone broken down into the following classifications:

None-no activity

Light-grazing signs observed but grasses generally over 6" high. Banks show sign of collapse from animal usage.

Moderate-grazing signs evident. Grasses generally 1" to 6" high, some cropping of willow, if present. Banks show signs of collaspe from animal usage.

Heavy-grasses cropped down to ground level, willows show signs of heavy browsing. Banks worn and collasping from animal usage.

Upland Ground Cover:

Poor--50% or less of ground covered. Trees essentialy absent and shrubs scattered. Shallow root mass.

Fair--50% to 75% of ground covered. Some trees present, root mass shallow.

Good--75% to 90% of ground covered. Shrubs and trees prevalent. Dense root mass.

Excellent--90+% ground cover. Trees, grasses, and shrubs all contribute to cover. Dense root mass.

Fish Species Present: Fish observed by surveyor. Salmonids are broken down into size classes; Y-O-Y - young of year, 1+ - one year or older (usually greater that 4" long), resident trout-fish found above barriers or over 8" long. Rough fish broken down by species only. Number present per 100 feet of stream will be denoted for all species present.

Channel Profile: Will be diagrammed at the stopping point at the end of each section. Width is the wetted portion of the stream. Depth measurements taken at points 1/4, 1/2, 3/4 of the stream width. Profiles of banks and vegetation types present also are diagrammed.

Pool/Riffle Inventory: This section of the survey form is designed to collect information on individual pools and riffles for each stream section surveyed. Riffles will be defined as that portion of the stream with a swift current and surface turbulence. Pools are any portion of the stream that do not fit this definition.

The inventory form is divided into six major categories for habitat assessment. These are: area, depth, velocity, substrate, cover, and quality. All components will be inventoried for riffles while only area, depth, cover, and overall quality will be considered for pools.

Lengths and widths of pools and riffles will be measured using a 100 foot tape or by pacing. Observers will calibrate their pace against a taped distance to ensure accurate measurements when using this technique. Area will be computed as a product of the length and width measurements and recorded in square feet.

Depth measurements will be taken using a wooden staff graduated in half foot increments. The appropriate depth range box (0-0.5, 0.5-1.5, 1.5-2.5, 2.5-3.0, 3+) will be checked.

Velocities (feet per second) will be estimated by using a floating stick method and the appropriate range box will be checked. Ranges are: 0-0.5, 0.5-1.0, 1.0-2.5, 2.5-3.5, >3.5. Average velocities will be recorded.

Substrate characteristics for riffles are divided into the following categories: (in.) M=mud, 0-1/16, 1/16-0.5, 0.5-1.5, 1.5-3, 3-4, 4-6, 6-12, 12-36, 36+, B=bedrock. Observers place an x in the box to indicate the most prevalent size category and a single check in up to three other categories that make up a significant portion of the remaining substrate.

Cover types are rated on a scale of 1-3 with "1" being the highest and "3" the lowest. If no cover is present in a certain category the box is left blank. Specific definitions of numbers used in quality ratings are:

1 - abundant cover: more than 50% of the perimeter or area of pool or riffle has that cover type.
2 - moderate cover: 25% to 50% of the perimeter or area of a pool or riffle has that cover type.
3 - light cover: less than 25% of perimeter or area of pool or riffle has that cover type. Cover types are divided into five categories:

Substrate--cover provided by substrates on the bottom.

Instream--cover provided by objects other than substrate in the stream. This includes stumps, logs, root wads and dead branches submerged or on the surface of the stream. This also includes rooted aquatic plants.

Turbulence--cover provided by water turbulence, usually bubbles or surface disturbances.

Bank--cover provided by undercut banks.

Overhead--cover provided by live overhaning vegetatioin.

The overall quality rating is based on a scale of 1-6, "1" being the highest or good rating and "6" being the lowest or poor rating. This rating is based on all information recorded for the habitat type.

Spawning Habitat Inventory: This section is designed to assess potential salmonid spawning habitat. Spawning quality is based on a scale of 1-3 with "1" being the highest and "3" being the lowest. The following criteria are used in assessing quality:

1 - high quality gravel, loosely packed, low sediment content

(<10%) and high probability of survival to emergence.

2 - good quality gravel, 10-20% sediment content with some packing. Probability of survival to emergence is fair.

3 - poor quality gravel, heavy silt and sediment content, very poor chance of survival.

Observers check any of three categories, fines, roots or crusted which indicate the factor(s) causing low gravel quality. Also noted are depth (ft.), velocity (fps) and area (sq. ft.) of the gravel observed and any additional comments.

The data from the pool/riffle inventory is used to complete the following categories on the stream survey form: average channel width (ft.), range of channel width (ft.), pool and riffle quality (%), (1 and 2-good, 3 and 4-fair, 5 and 6-poor), total pool area (yds^2.), average pool depth, spawning gravel quality and area (yds^2.).

A photo record will be kept for each stream section documenting any unusual or typical features and problem areas such as bank cutting, beaver dams, barriers, diversions, etc. Photos looking upstream and at the left and right banks (while looking upstream) will be taken at the end point of each station.

Comments will be recorded by the surveyor giving a brief description of the section walked and discussing any features that are prominent. Also included are factors limiting fish production such as barriers, poor spawning gravel, and poor rearing habitat.

Channel Stability Evaluation: This form will be used to evaluate bank and channel stability. The procedures and criteria used in filling out this form are described in "Stream Reach Inventory and Channel Stability Evaluation," USDA, Forest Service, Northern Region, 1978. A final numeric value will be obtained for rating the section's stability. Stream order, stream stage, sinuousity ratio and size composition of bottom material are included on this form.

Fishery Habitat and Stream Stability Features: Surveyors will take aerial photos with mylar overlays or copies of USGS topographic maps when photos are not available, to record feature symbols in the field. These will then be transferred onto permanent maps after field work is complete.

Special Feature Forms: Special feature forms will be used to record specific information such as dimensions and barrier potential for culverts, falls and chutes, diversions, log jams and landslides.

CLEAR AND GRANITE CREEKS ANADROMOUS FISH HABITAT IMPROVEMENT

ANNUAL REPORT, 1982

By

John Andrews, Fishery Biologist
Umatilla National Forest
Pendleton, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP11897
Project No. 83-394
Project Officer: Larry Everson

TITLE: Clear Creek and Granite Creek (North Fork John Day River) Spawning Gravel Sieving and Placement Project

FINAL REPORT

AGREEMENT NO. DE A179-82BP36726
(BPA Project 82-9; John Day)

PROJECT PERIOD: May 21, 1982 to January 31, 1983

EXECUTIVE SUMMARY: Spawning gravel was screened and placed in Clear Creek.

ABSTRACT: During July and August 1982, 10,000 cubic yards of spawning gravel 1/2 to three inches in size was screened from gold dredge tailings. Approximately 6,500 cubic yards of screened gravel was placed at 138 spawning sites. The remaining 3,500 cubic yards were stockpiled for future use.

Introduction:

Dredging operations on Granite and Clear Creeks began in the 1920s and continued until 1954. This activity removed major portions of spawning gravel and completely altered the natural hydrology of these streams. Anadromous fish habitat in the area has not fully recovered from the dredging activity.

Due to the major contribution these streams make to anadromo us fish runs in the North Fork John Day River system, it was recognized that further rehabilitation work was needed. In 1959 and 1961, the Oregon Department of Fish and Wildlife moved dredge tailings into the Clear Creek channel and increased spring chinook salmon spawning. Due to a lack of control structures, most of this material was displaced downstream (Oregon State Game Commission, 1965). Portions of Clear and Granite Creeks on the Umatilla National Forest were withdrawn from mineral entry in 1963 and 1968. A project proposal was prepared in 1965, amended in 1967, and revised again in 1979 by the Dale District, Umatilla National Forest. The Oregon Department of Fish and Wildlife (ODF&W) reveiwed and concurred with the 1979 revision (USDA Forest Service, 1967, 1979).

During 1979, 1981, and 1982, the Umatilla National Forest conducted a fish habitat rehabilitation project on Clear Creek from stream miles 0.5 to 4.5 to improve spring chinook salmon habitat. Log weirs and other channel stabilizing structures have changed the percent pool from 12 percent to 60 percent. An estimated 5,000 square yards of spawning gravel will be needed to provide juvenile recruitment to take advantage of the increased rearing pools.

A stream survey conducted by ODF&W in the early 1960's revealed that anadromous fish spawning gravel in Clear Creek was grossly deficient. During 1980, an extensive stream survey found only 321 square yards of spawning gravel in the project area of Clear Creek. An anlysis was conducted on known spring chinook salmon redds to determine the size gravel needed for optimum chinook spawning success which was determined to be 1/2 to three inches in diameter. The BPA project was designed to add proper size spawning gravel to the stream in sufficient quantities to meet future spring chinook spawning demand.

Project Description:

The project is located in the lower portion of Clear Creek in T.9S., R.35E. Clear Creek is the primary tributary to Granite Creek which in turn is a major tributary to the North Fork John Day River.

Project activities consisted of preparing and administering contracts to screen 10,000 cubic yards of 0.5 to 3.0 inch gravel from the gold dredge tailings adjacent to Clear Creek, placing 6,500 cubic yards of the screened gravel in the stream, about 4,875 square yards of spawning area, and stockpiling the remaining 3,500 cubic yards for future use.

The gravel screening contractor worked from June 14 to July 24 and utilized two screens (0.5 and 3.0 inch) to sort the gravel to optimim size for anadromous fish spawning (Photo No. 1). The contractor hauled 6,500 cubic yards of screened gravel to the spawning bed sites, utilizing a three yard loader and two 10 yard dump trucks.

The gravel placement contractor operated from July 26 to August 19. He used a 3/4 yard crawler backhoe and a smaller crawler loader backhoe to place the screened gravel in 138 spawning beds in Clear Creek from stream miles 0.5 to 4.5.

The spawning beds were located at the tailout of existing and constructed pools (Photo No. 2). The beds were constructed by removing the rubble and large boulders remaining from gold dredging (Photo No. 3) and replacing them with the screened gravel to a depth of four feet (Photo Nos. 4 and 5).

It is estimated that the amount of spawning gravel in the project area of Clear Creek has been increased from the 321 square yards recorded in 1980 to 5,196 square yards as the result of this project.

Results and Conclusions:

It was expected that the newly placed gravels would receive little use by spring chinook salmon the first year. It was a pleasant surprise to see the adult salmon move on to the constructed spawning beds a week earlier than normal and begin to spawn (Photo Nos. 6, 7, and 8).

Verbal communications from Brad Smith (ODF&W Research) indicates that over fifty percent of last fall's spring chinook spawning in Clear Creek took place on the newly placed spawning gravel.

It is anticipated that the increased spawning area will result in less crowding of spring chinook redds, increased survival of deposited eggs, and an increase in the number of fry available so that adequate seeding of the increased rearing area would occur.

As a minimum, ten square yards of spawning gravel should be available for each redd (Claire, 1963). The 47 redds counted in 1981 (Lindsay, 1982) were crowded into 6.8 square yard average (Table 1). The gravel placement project increased the spawning area to an estimated 22.1 square yards per redd for the projected 235 redds that could result from the total enchancement project.

An estimated increase in smolt production of 20,000 spring chinook smolts annually could result from the gravel placement project. These smolts would provide 200 additional escaping and 600 harvested adults which would have an estimated net value of $110,000 using National Marine Fisheries Service economic values (Meyers, 1982).

Table 1

Estimated Smolt Production Increase

Before Clear Creek Project

Square yards spawning area	321
Square yards per redd	6.8
Redds counted in 1981	47
Smolts per redd[1/]	x 320
Smolt production before:	15,000

After Clear Creek Project

Square yards spawning area	5,196
Square yards per redd	22.1
Redds projected future (47 x 5)[2/]	235
Smolts per redd[1/]	x 320
Smolt production after:	75,000
Increased smolt production	60,000
Increased smolt production[3/]	
Due to spawning gravel project	20,000
One percent spawning escapement	x .01
Adult spawners	200
Net value per escaping spring chinook[4/]	$ 550
Estimated annual value of spawning gravel	$110,000

[1/] As per conversation with Brad Smith, ODF&W. Each redd averages about 4,000 eggs which average eight percent survival (4,000 x 0.08 = 320).
[2/] Fivefold pool increase from 12% to 60%.
[3/] Total cost project $270,000; spawning gravel project cost $88,855 or approximately one-third of total cost.
[4/] Meyer, 1982.

REFERENCES

Claire, Errol, 1983. Personal communication on January 24, 1983.

Lindsay, R.B., et al., 1982. "Spring Chinook Studies in the John Day River, 1981," Oregon Department of Fish and Wildlife, 48 pages, 1982.

Meyers, Philip A., 1982. "Net Economic Values for Salmon and Steelhead from the Columbia River System," USDC, National Marine Fisheries Service, 26 pages, June 1982.

Oregon State Game Commission, 1965. "Habitat Improvement Project, Clear Creek Project Number 11," 10 pages, 1965.

Smith, Brad, 1983. Personal communication on January 24, 1983.

USDA, Forest Service, 1967. "Clear Creek and Granite Creek Rehabilitation Project," Umatilla National Forest, 18 pages, 1965, revised 1967.

USDA, Forest Service, 1979. "Granite Creek-Clear Creek Rehabilitation Project for Anadromous Fish Environmental Assessment Report," Umatilla National Forest, 13 pages, May 15, 1979.

Photo No. 1. Gravel Screening Operation

Photo No. 2. Spawning gravel beds
were placed behind each log weir.

Photo No. 3. Boulders and rubble prior to rehabilitation. Dredge tailing pile in background.

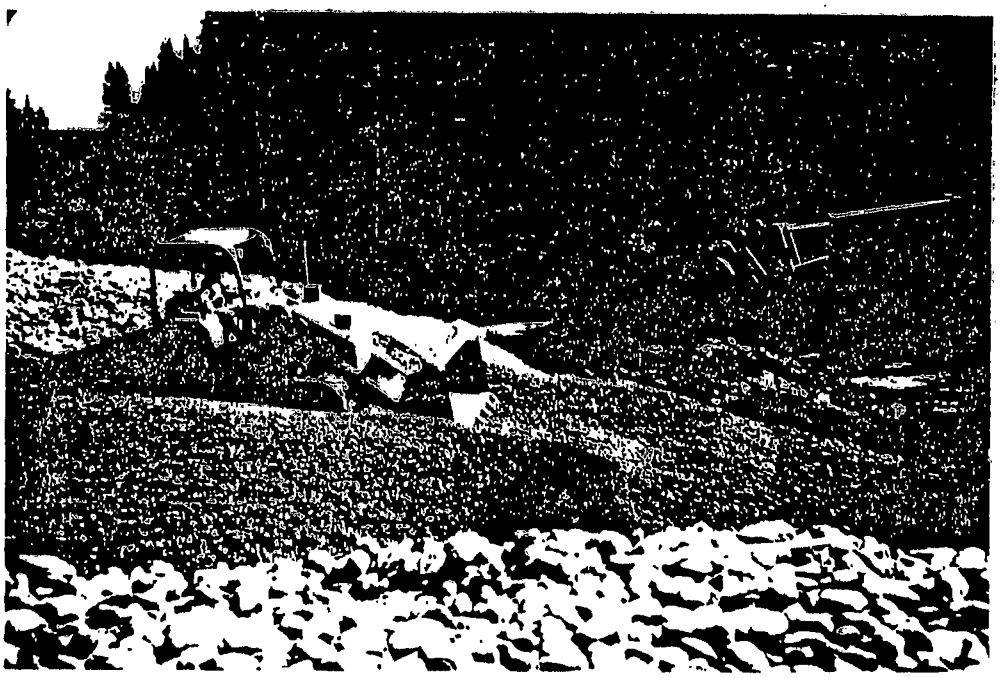


Photo No. 4. Crawler loader pushing gravel to backhoe.

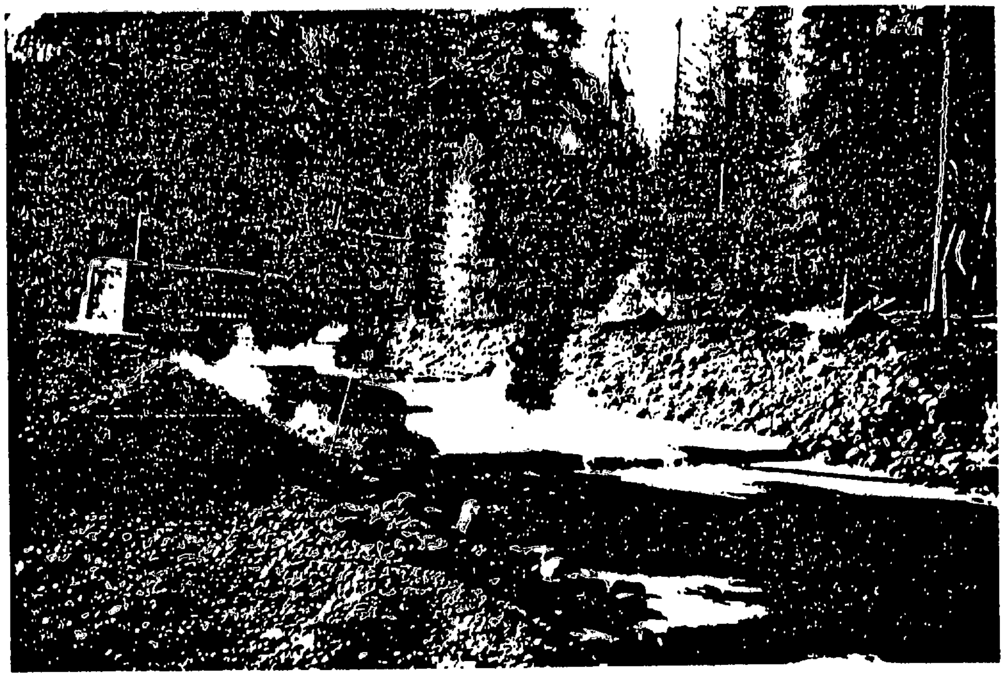


Photo No. 5. Spawning gravel being placed in Clear Creek.

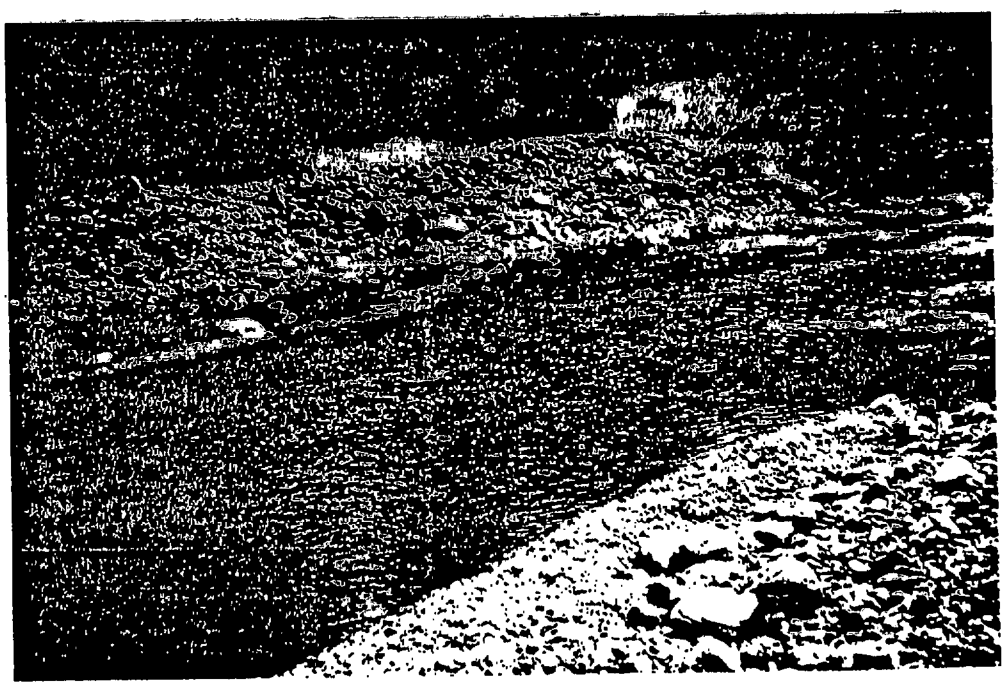


Photo No. 6. Spawning salmon in Clear Creek. Gravel placed in stream approximately one week earlier.

Photo No. 7. Salmon using the new gravel redd.

Photo No. 8. Salmon and redd in same area as Photo No. 3.

CLEAR AND GRANITE CREEKS ANDROMOUS FISH HABITAT IMPROVEMENT

ANNUAL REPORT, 1983

By

John Andrews, Fishery Biologist
Umatilla National Forest
Pendleton, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP11897
Project No. 83-394
Project Officer: Larry Everson

CONTENTS

SUMMARY:

During July 1983, the Umatilla National Forest installed 600 large boulders in Clear and Granite Creeks to increase the amount of cover for rearing juvenile anadromous fish. In addition, 650 cubic yards of riprap were placed along 400 feet of unstable streambank to prevent sedimentation of anadromous fish redds.

INTRODUCTION:

The commercial and recreational values of Oregon's anadromous salmon and steelhead fisheries are well known. The John Day River and its tributaries are important areas for natural anadromous salmonid reproduction. The Clear Creek and Granite Creek drainages are major tributaries to the headwaters of the North Fork of the John Day River (Oregon Game Commission, 1959).

The project area is located in the northeast corner of Grant County on the extreme east side of the Dale Ranger District, Umatilla National Forest in T.8S., R.35E., and T.9S., R.35E. (Figure 1)

Dredging operations on Clear and Granite Creeks began in the 1920's and continued to 1954. These dredging activities removed major portions of the spawning gravel and changed the natural streamcourse and hydrology of Clear and Granite Creeks in this area (USDA, Forest Service, 1967 and 1979). The anadromous fish habitat in the area has still not recovered from this dredging.

In 1963 and 1968, portions of Clear and Granite Creeks on the Umatilla National Forest were withdrawn from mineral entry. These withdrawals are located in Section 19, 28, 29 30, and 35, T.8S., R.35E. and Sections 2, 10, 11, 14, and 15, T.9S., R.35E.

In 1965, the Clear Creek and Granite Creek Rehabilitation Report was prepared by the Dale District Ranger. The revised report was in 1967 (USDA, Forest Service, 1967). An Environmental Assessment Report was completed and approved in March 1979 for the project portions of Clear and Granite Creek (USDA, Forest Service, 1979).

Rehabilitation work has been varied. In 1961, the Oregon Game Commission (OGC) ODFW pushed 13,160 cubic yards of tailing piles into Clear Creek at a total of 48 spawning gravel sites. This work was successful in that a very high percentage of salmon spawning took place on these sites during the following decade (OGC, 1965). At least two attempts at establishing willows by planting cuttings have been made, but both have met with very poor results due to stream fluctuations and limited amount of fertile soil along the stream (Johnson, 1983).

The major work in the area has been on a four-mile section of Clear Creek in 1979, 1981, 1982, and 1983. This work has been a cooperative venture. ODFW has been heavily involved in the planning stage as well as doing most of the monitoring in conjunction with a research project they are doing on the North Fork John Day River system. Bonneville Power Administration provided major financing in 1982 and 1983 through the Northwest Power Act. The USFS has been responsible for the planning and administration.

PROJECT DESCRIPTION:

Project activities consisted of preparing and administering a contract to place boulders and riprap in Clear and Granite Creeks. In addition, spawning gravel was placed in Clear Creek, all disturbed areas were seeded with grass, and hardwoods were planted adjacent to the stream.

Boulders and riprap were hauled from a rock pit near Granite and stockpiled at work sites. The boulders were placed in the stream in groups of four to twelve per cluster utilizing a large crawler excavator. Five hundred and fifty boulders were placed in Clear Creek and fifty boulders were placed in Granite Creek.

A total of six hundred and fifty cubic yards of riprap was placed along 400 feet of streambank. Two hundred cubic yards of riprap was placed along the upper end of the Clear Creek channel change (river mile 4.5). The remaining riprap was placed as small rock deflectors at forty-nine erosion sites.

Five hundred cubic yards of spawning gravel were placed in twenty-five spawning beds. Test plantings of forty, 10-15 foot long willow poles and forty large hardwood clumps were made in several streamside areas where riparian vegetation has not reestablished naturally.

PROJECT COSTS:

a.	Salaries		$ 5,495.43
b.	Transportation and travel		756.88
c.	Materials and supplies1/		894.94
d.	Equipment rental contract		19,171.00
		Subtotal	26,318.27
		Overhead @ 12.5%	3,004.48
		Total	$29,322.73

1/ No major property purchased.

RESULTS AND CONCLUSIONS:

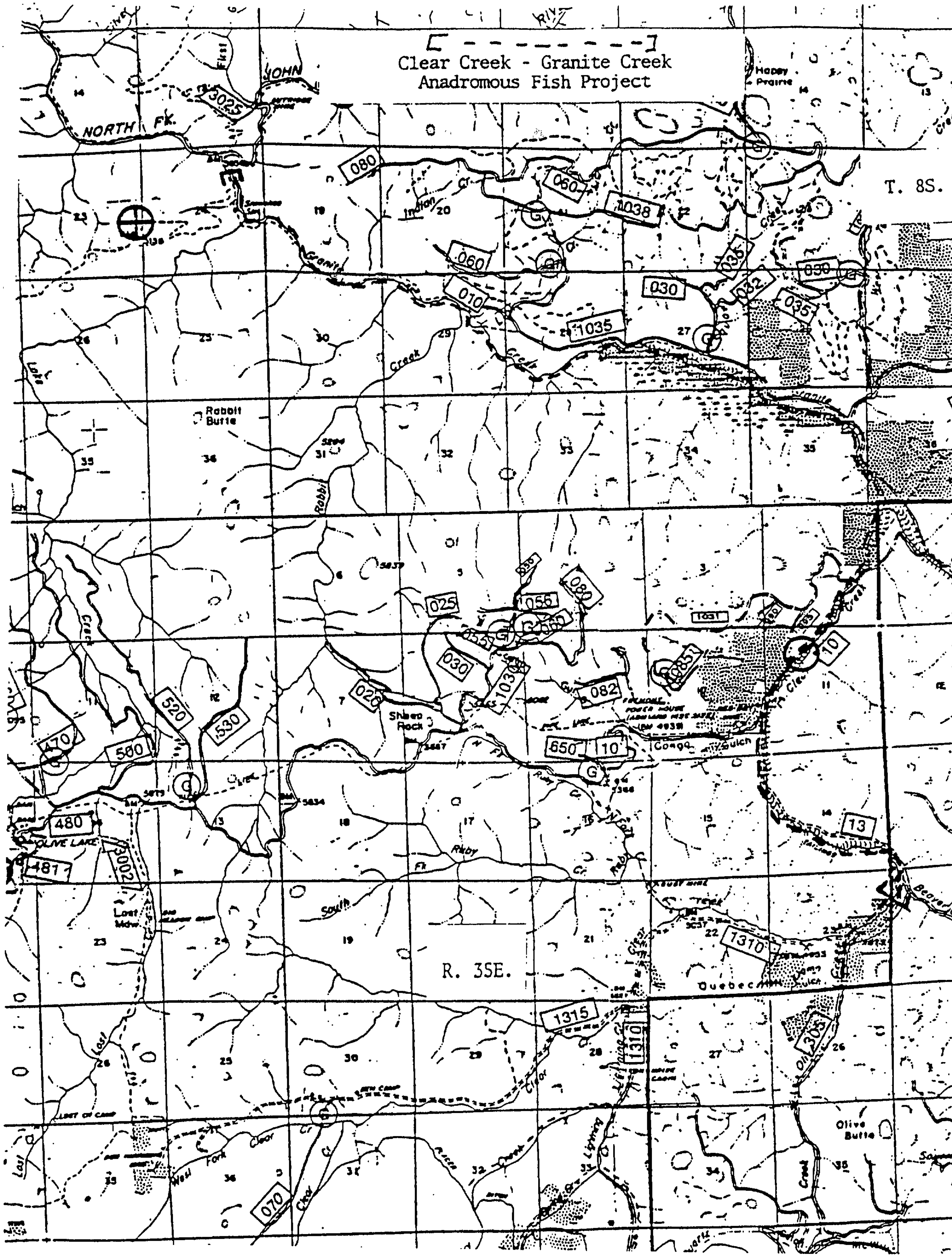
Anadromous fish in the North Fork John Day sub-basin are maintaining themselves at very low population levels. It is anticipated that the increased rearing area associated with the boulders and riprap structures will result in increased anadromous fish survival from egg to smolt. This increase is estimated at 3,250 smolts annually (Table 1). These smolts would provide 20 additional escaping adults which would have an estimated net value of $11,000 using National Marine Fisheries Service Economic Values (Meyers, 1982).

Table 1

Estimated Smolt Production Increase

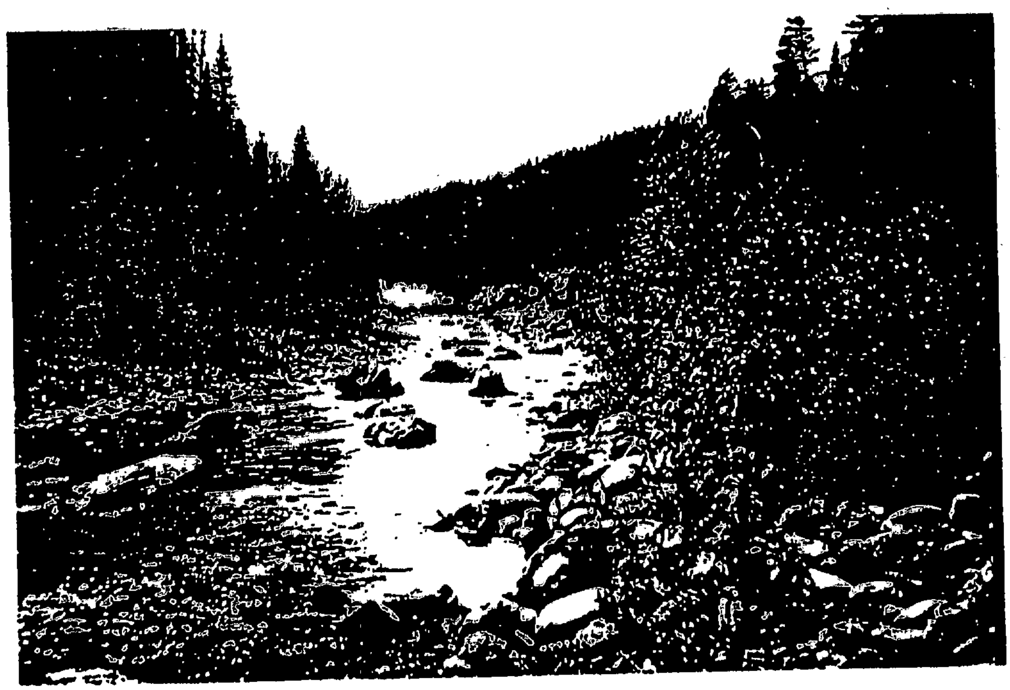
Boulders and riprap structures	650
Smolts per structure	x5
Estimated increase smolt production	3,250
@ 0.625 percent spawning escapement 1/	x.00625
Estimated increased adult spawners	20
Net value per escaping chinook 2/	x$500
Estimated annual value 1983 BPA project	$11,000
Benefit-Cost Ratio 3/	5:1

1/ As per conversation with Errol Clair 3/5/84.
2/ Meyer 1982.
3/ Based on 4% interest for a 20-year project life.



Clear Creek - Granite Creek
Anadromous Fish Project
T. 8S.
R. 3SE.
NORTH FK.
JOHN
3025
080
060
1038
010
030
032
035
036
1035
Granite
Creek
Indian
Rabbit Butte
Happy Prairie
025
056
080
030
020
1030
082
1031
10
13
520
530
470
500
480
OLIVE LAKE
481
3002
650
Sheep Rock
Congo Gulch
Ruby
South
Lost Mdw.
1310
1315
Quebec
305
Olive Butte
West Fork Clear Cr
070
Lightning
Beaver

Riffles in Clear Creek had very little Andromous Fish rearing potential.



The addition of boulders have created more instream habitat for Andromous Fish fingerlings.

Even adult Chinook Salmon used the
boulder placements.

A large backhoe was used to place
riprap in eroding areas.

Large hardwood clumps were planted along the stream edge to provide shade and cover.

Clump survival up to October was excellent. However, some loss is expected over winter.

REFERENCES:

Claire, Errol, 1984. Personal communication on March 5, 1984.

Johnson, Greg, 1983. Personal communication on May 31, 1983.

Meyers, Philip A., 1982. "Net Economic Values for Salmon and Steelhead from the Columbia River System," U.S. Department of Commerce, 23 pages, June 1982.

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NORTH FORK JOHN DAY RIVER ANADROMOUS FISH HABITAT IMPROVEMENT

ANNUAL REPORT, 1983

By

John Andrews, Fishery Biologist
Umatilla National Forest
Pendleton, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP11855
Project No. 83-395
Project Officer: Larry Everson

CONTENTS

SUMMARY:

The Forest completed all construction work planned for 1983. This work consisted of opening six side channels, constructing 16 weirs to increase pool percentage, and placing 492 large boulders in side channels and the main river to provide instream cover.

INTRODUCTION:

The John Day River and its tributaries are important areas for natural anadromous salmonid production. The North Fork John Day River is a major contributor to this production.

Current estimated spring chinook smolt production for the 42 miles of main stream North Fork John Day River on the Umatilla National Forest is 110,000 smolts annually. There is an estimated potential of producing 329,000 smolts annually if habitat conditions are brought to optimum levels.

Nine miles of the North Fork John Day offer the opportunity to significantly increase smolt production at low cost. Degradation by gold dredging in this area began in 1939 and ended in 1950. Dredging activities changed the natural course and hydrology of the North Fork John Day River. The anadromous fish rearing habitat in this portion of the river has not recovered from the impacts of this dredging.

During August 1971, the Oregon State Game Commission in cooperation with the U.S. Forest Service increased the juvenile spring chinook rearing area by pushing dredge tailings into the river. This forced a portion of the stream flow down several natural secondary channels that were left dry by the dredging.

In 1979, 80, and 81, the Umatilla National Forest reopened ten additional side channels and placed large boulders in the river at several locations in order to increase juvenile spring chinook rearing habitat. During August 1982, the Forest Service constructed three weirs and placed 67 large boulders in a side channel opened in 1981.

Monitoring of the project results has been coordinated with the Oregon Department of Fish and Wildlife research section. Initial results indicate that the number of juveniles rearing has increased from virtually zero in the dry or nearly dry side channels to approximately 25 fingerlings per 100 feet in an opened but unimproved channel to 100 fingerlings per 100 feet in an improved channel.

PROJECT DESCRIPTION:

Project activities consisted of preparing and administering a contract to construct side channels to the North Fork John Day River, place boulders in the side channels and main river, and construct boulder weirs in the side channels.

The contractor began work on July 28, 1983, and construction was completed on August 19, 1983. Boulders and riprap were hauled from a pit at the Ukiah-Dale wayside and stockpiled at work sites.

Four hundred and ninety-two boulders were placed in the North Fork John Day River between river miles 72.5 and 76.0. An excavator was used to dig a key and rearing pool and place the boulder in the key. The boulders provide physical cover for rearing juvenile salmon as well as creating turbulence and pools which provide additional cover.

The six side channels were excavated to grade and the boulder weirs were constructed prior to opening the channels. A flow control structure was constructed at the entrance of each side channel to take between 20 and 30 percent of the main river flow. Riprap was used to protect unstable banks and to construct rock deflectors for increased juvenile fish rearing.

PROJECT COSTS:

a.	Salaries		$ 6,554.34
b.	Transportation and travel		696.42
c.	Materials and supplies 1/		277.55
d.	Equipment rental contracts		34,212.50
		Subtotal	41,740.81
		Overhead @ 12.5%	4,859.21
		Total	$46,600.02

1/ No major property purchased

RESULTS AND CONCLUSIONS:

Anadromous fish in the North Fork John Day sub-basin are maintaining themselves at very low population levels. It is anticipated that the increased rearing area associated with the boulders, rock weirs, and side channels will result in increased anadromous fish survival from egg to smolt. This increase is estimated at 7,260 smolts annually (Table 1). These smolts would provide 45 additional escaping adults which would have an estimated net value of $24,750 using National Marine Fisheries Service Economic Values.

Table 1

Estimated Smolt Production Increase

492	Boulders @ 5 smolts/boulder	2,460
16	Rock weirs @ 50 smolts/rock weir	800
3.3	Miles side channel @ 1,200 smolts/mile	4,000
	Estimated increase smolt production	7,260
	@ 0.625 percent spawning escapement 1/	x.00625
	Estimated increased adult spawners	45
	Net value per escaping chinook 2/	x$550
	Estimated annual value 1983 BPA project	$24,750
	Benefit-Cost Ratio	7.2:1

1/ As per conversation with Errol Clair 3/5/84.
2/ Meyers 1982. "Net Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.
3/ Based on 4% interest for a 20-year project life.

On October 13, 1983, Umatilla National Forest and ODFW personnel sampled a short stretch of riffle and pool in two of the newly opening side channels and in two previously opened side channels (Table 2). Of interest is the density of spring chinook (ChS) presmolts found in channels 16 (23.5 ChS per 100 meter^2) and 18 (13.7 ChS per 100 meters^2) which were constructed this year. If these densities are expanded to include the 24,000 meters^2 of channel constructed in 1983, it can be estimated that 4,000 ChS presmolts were rearing in the new channels the first fall, as compared to no ChS production when the channels were dry.

Table 2

Juvenile Spring Chinook Monitoring
North Fork John Day River Side Channels, October 13, 1983

River Mile	Channel	Distance Sampled (M)	Juvenile Spring Chinook Cpatured 1st Pass	Juvenile Spring Chinook Cpatured 2nd Pass	Population Estimate 1/	Fish Density Per 100 Sq. Meters
67.6	3	59.4	43	8	53	14.0
68.3	4	48.5	14	5	22	15.8
73.3	16 2/	55.8	40	4	44	23.5
74.0	18 2/	108.8	85	19	109	13.7

1/ Calculated using the Calvin Zippen Removal Method of population estimation.
2/ Channels 16 and 18 were dry prior to August 1983.

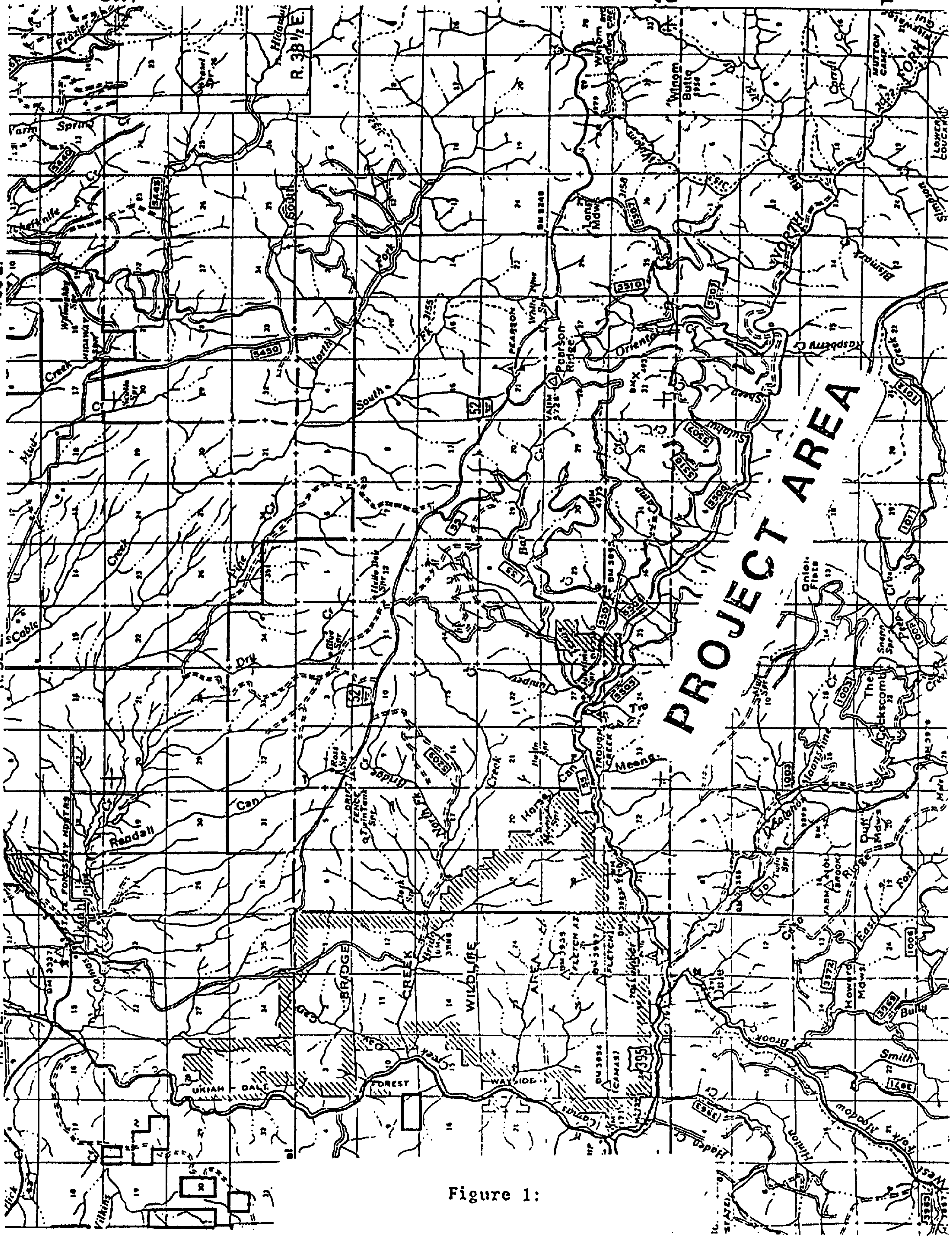
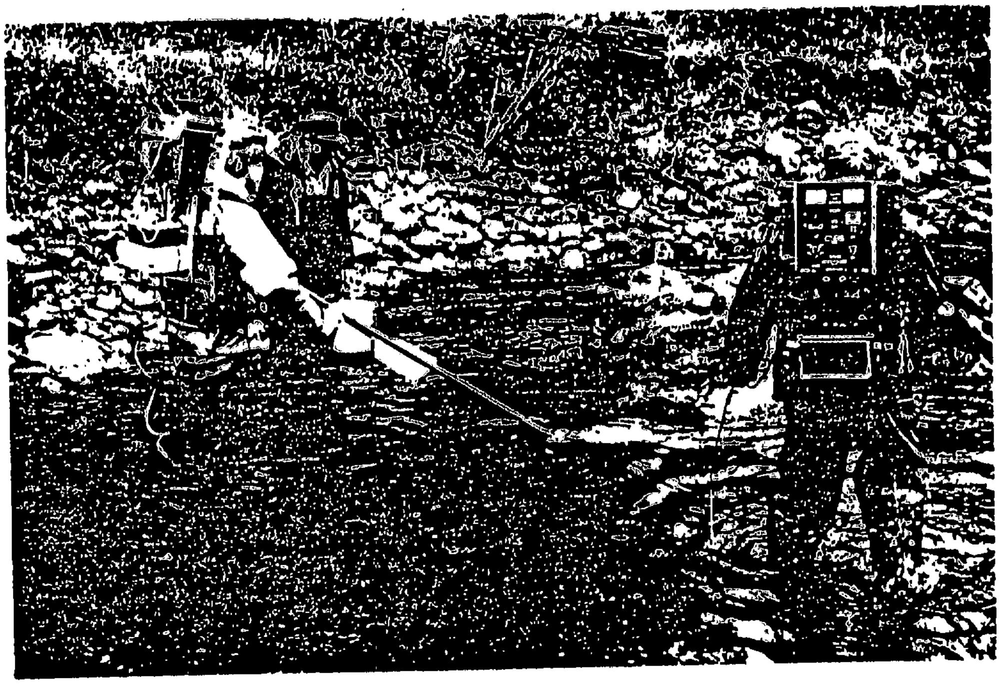
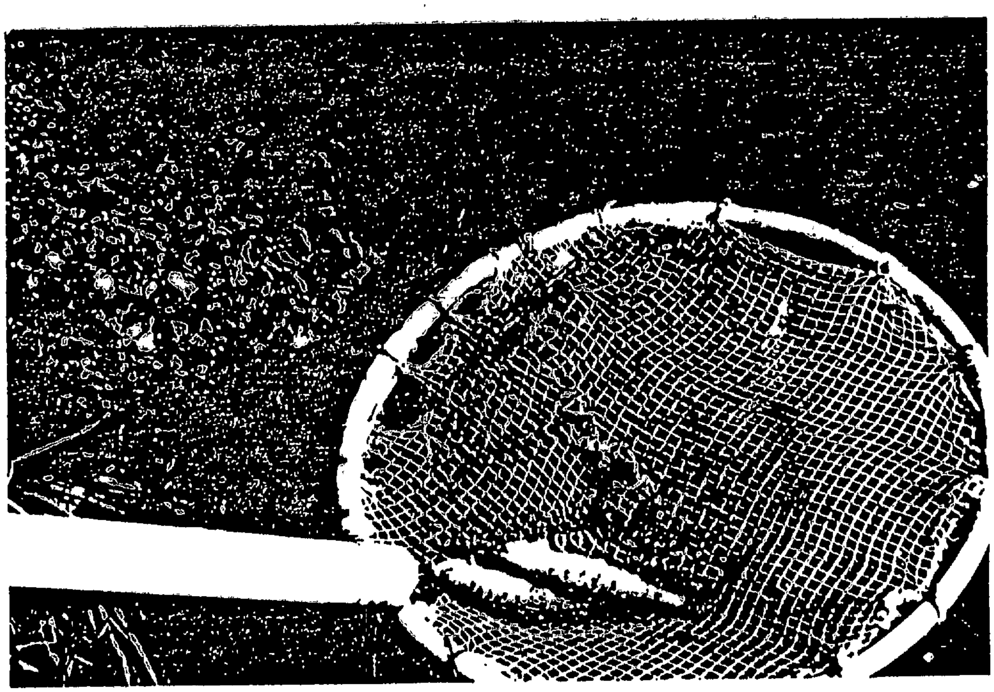

PROJECT AREA
T.5 S.
T.6 S.
T.7 S.
R. 33 E.
R. 32 E.
R. 31 E.
R. 33½ E.
BRIDGE CREEK WILDLIFE AREA
UKIAH DALE FOREST WAYSIDE

Figure 1:



Two electro-shockers were used to capture fish in the side channel riffles.



3-4 inch juvenile spring Chinook Salmon from Side Channel 18.

JOHN DAY RIVER HABITAT ENHANCEMENT EVALUATION

ANNUAL REPORT, 1983

By

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Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP39801
Project No. 82-9
Project Officer: Larry Everson

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SUMMARY

Objectives

The following objectives apply to Deer, Camp, and Clear creeks, unless stated otherwise.

1. Establish sampling stations in areas where stream habitat has been improved (treatment) and where it has not (control) in each stream.
2. Estimate rainbow-steelhead and chinook densities in treatment and control areas. Chinook densities will be estimated in Clear Creek only.
3. Collect a random sample of fork lengths of rainbow-steelhead. Chinook will be measured in Clear Creek only.
4. Collect a random sample of scales of rainbow-steelhead.
5. Document changes in stream depth, width, volume, pool/riffle ratio, spawning gravel, and cover as a result of habitat improvement projects.
6. Establish photopoints at selected sites.

Accomplishments

We accomplished all objectives.

Findings

Mean densities of rainbow-steelhead associated with each of four types of habitat improvement structures in Deer Creek ranged from 16% to 119% higher than in a control section where no improvements were made. However, there was little difference in density of rainbow-steelhead between improved (treatment) and control areas in Camp Creek (125 and 130 fish/100m, respectively) in 1983, the first year after the completion of habitat improvements.

Densities of rainbow-steelhead and spring chinook were lower in 1983 than in any pre-treatment year in lower Clear Creek. However, the mean density of chinook in upper Clear Creek increased from a pre-treatment high of 3 fish/100m to 17 fish/100m in 1983. This increase was due to higher flows as a result of channel modifications and as a result of construction of side-channel dams which raised the watertable and increased subterranean flow into the main channel. The higher flow improved passage for adult chinook into the upper reaches of the treatment area.

INTRODUCTION

The Oregon Department of Fish and Wildlife (ODFW) began a study in March 1983 to document changes in chinook salmon and steelhead production due to habitat improvments in tributaries of the John Day River. The projects being studied are located in Deer Creek, a tributary of the South Fork of the John Day River at km 45; Camp creek, a tributary of the Middle Fork of the John day River at km 77; and Clear Creek, a tributary of Granite Creek which flows into the North Fork of the John Day River at km 141. This report describes study areas, methods, and results through 30 September 1983.

METHODS

Objective 1

Deer Creek

We sampled in Deer Creek to estimate the abundance and age/size structure of rainbow-steelhead and to document physical changes of the stream associated with each of the following structure types: (1) log weirs, (2) rock weirs, (3) log deflectors, and (4) boulder placements. The physical factors measured were stream depth, stream width, pool/riffle ratios, cover, and spawning gravel area. Because the four structure types were interspersed with one another in the treatment area, the boundaries of each sampling station were established at points above and below an individual structure where the physical character of the stream was no longer influenced by that structure. Areas influenced by adjacent structures of different types were not included as sampling stations. Sampling stations ranged from 9m to 50m in length; the boundaries of each were marked with numbered metal stakes (Fig. 1).

Six control stations, each approximately 50m long, were established in Deer Creek above the uppermost habitat structure. Control stations were selected in areas similar in substrate, gradient, depth, and cover to the treatment areas prior to contruction of habitat structures. Station boundaries were marked with numbered metal stakes at natural breaks such as riffles or the head of pools (Fig. 1).

Camp Creek

Sampling areas were established in Camp Creek to estimate changes in abundance and age/size structure of rainbow-steelhead and to document changes in physical factors in the stream due to log weirs. Physical factors measured were the same as in Deer Creek. Treatment areas were those in which log weirs were present and control areas were those in which log weirs were not present. Treatment and control areas were interspersed throughout the length of the stream (Fig. 2). Sixteen, 50m sampling stations were systematically established in each of the treatment and control areas. The distribution of samplilng stations within each treatment and control area is shown in Table 1. Station boundaries were established at natural breaks whenever possible and were marked with numbered stakes.

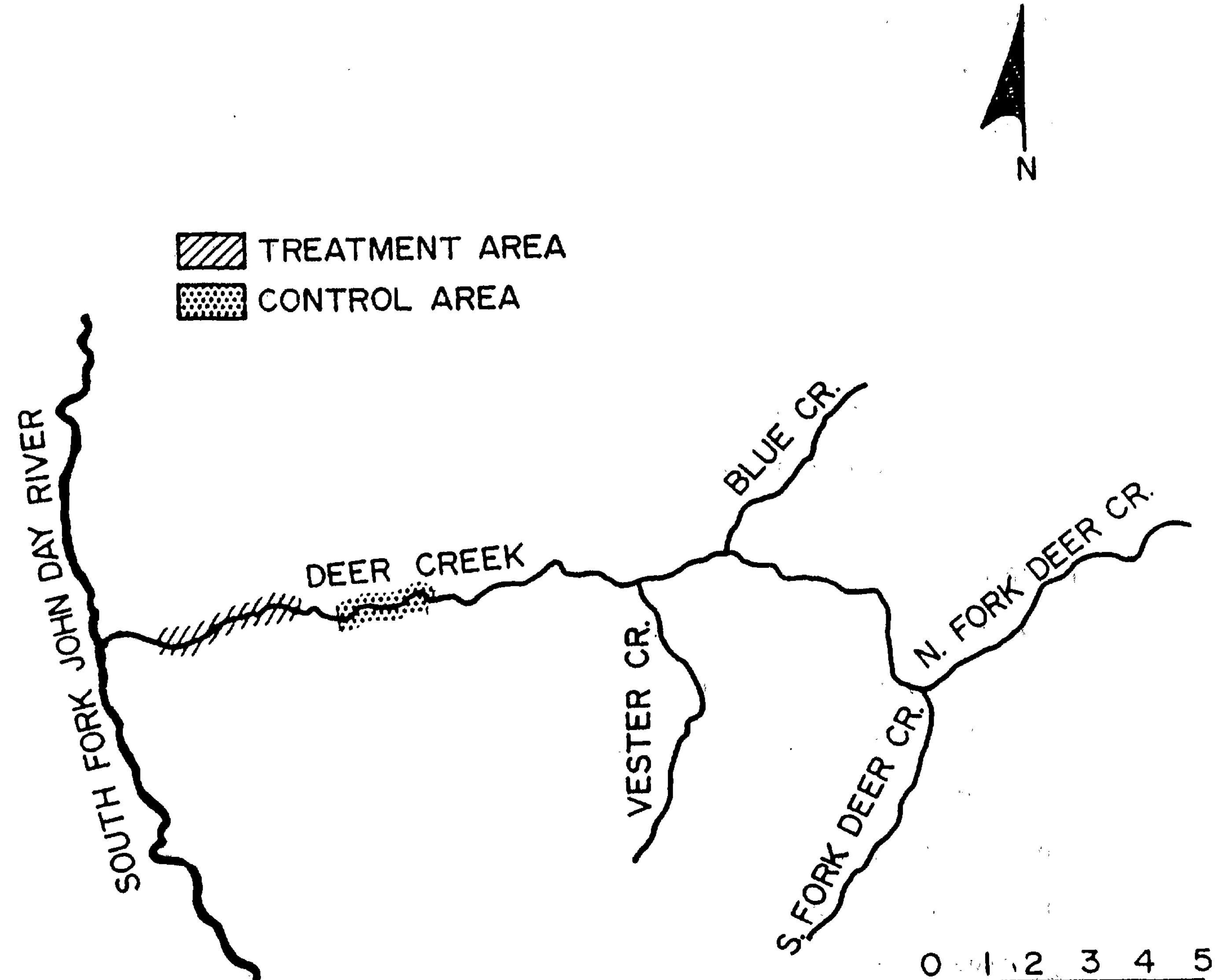

Fig. 1. Location of sampling areas in Deer Creek.

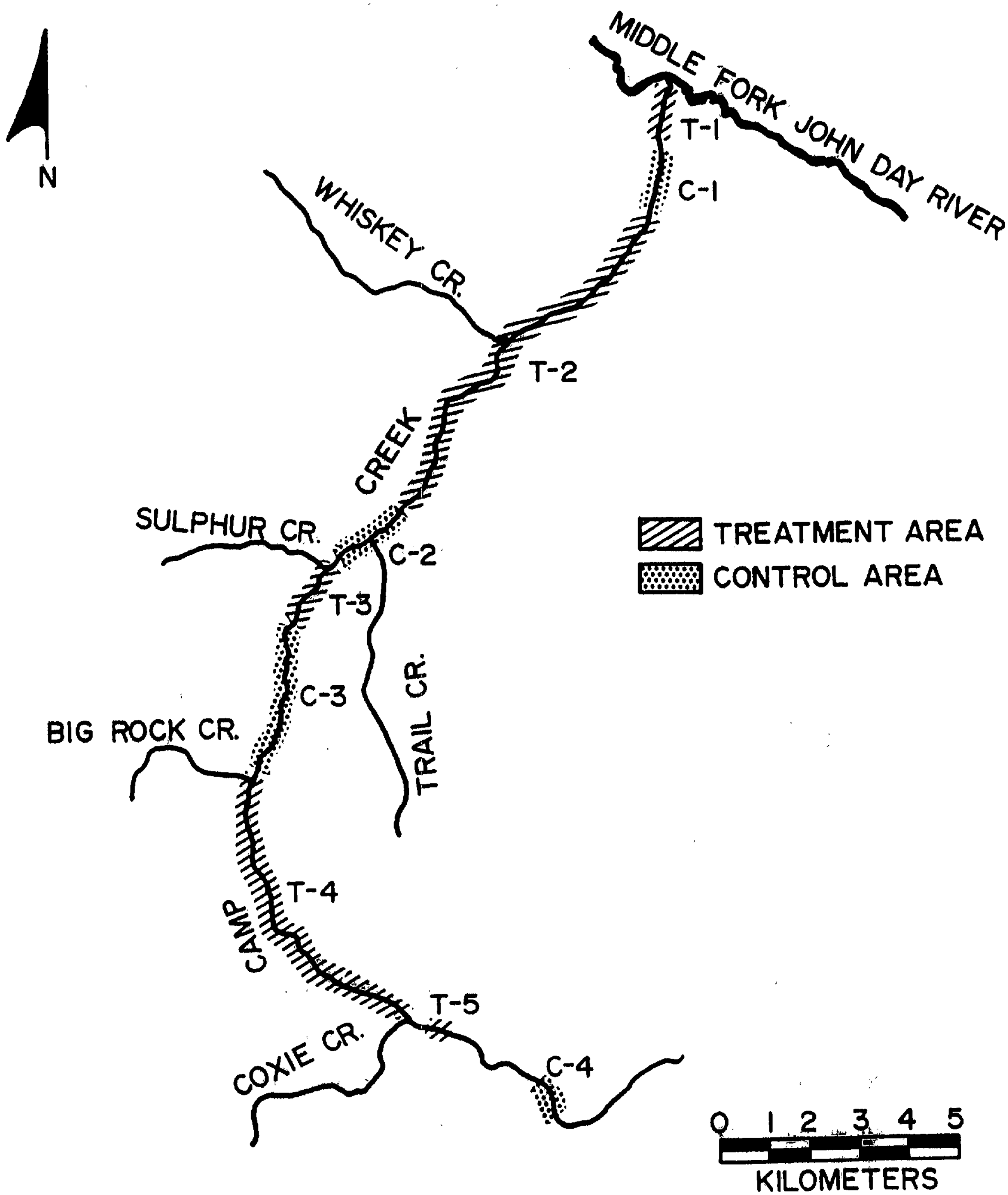

Fig. 2. Location of sampling areas in Camp Creek.

Table 1. Distribution of sampling stations in treatment and control areas of Camp Creek.

Sampling segment	Number of sampling stations
Treatment	
T-1	1
T-2	7
T-3	1
T-4	6
T-5	1
Control	
C-1	3
C-2	3
C-3	8
C-4	2

Six sampling stations were also established as controls in Slide Creek (Fig. 3), a tributary of the Middle Fork at km 52. These stations will be used as external controls to determine if any major changes are occurring in the control stations in Camp Creek because of their close proximity with treatment areas. Sampling stations in Slide Creek were selected to duplicate as closely as possible, the substrate,depth and cover of control stations in Camp Creek, however, flows are lower in Slide Creek.

Clear Creek

Twenty-four sampling stations, ranging from 37m to 73m in length, were established in Clear, Granite, and Bull Run creeks to estimate changes in the density of spring chinook and rainbow-steelhead due to the introduction of spawning gravel; the construction of log weirs, boulder placements, and holding pools; and the recovery of subterranean flows.

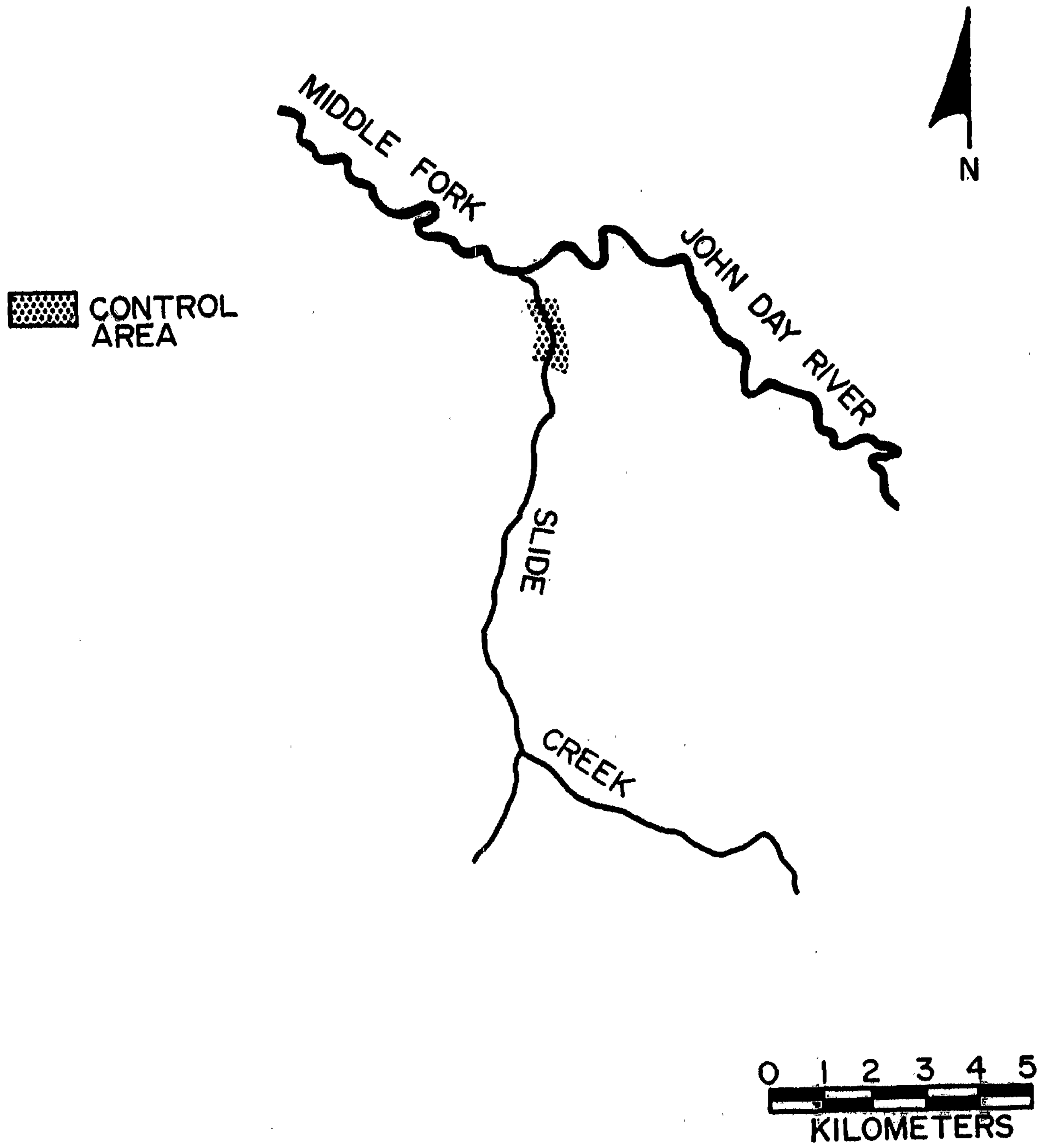

Fig. 3. Location of sampling area in Slide Creek.

Twelve sampling stations were established in Clear Creek in as close as possible to the same locations as the original twelve stations in which pre-treatment data were collected from 1979 through 1981. It was impossible, however, to locate exactly the original sampling stations because of the habitat changes. Of the twelve stations in Clear Creek, six are in upper Clear Creek and six are in lower Clear Creek (Fig. 4). Each of the six stations in upper Clear Creek were bounded by weirs and each included one to two weirs. Each station was separated by at least one weir. Boulder placements were not included in these stations. Each of the six sampling stations in lower Clear Creek contained one weir with station boundaries being natural riffle breaks above and below the weir. Three of these stations included boulder placements.

Six control stations were systematically selected in each of Granite and Bull Run creeks in areas (Fig. 4) similar in gradient and substrate to Clear Creek prior to habitat changes. Natural breaks (ie. riffles) were used as station boundaries. Numbered metal stakes were used to mark the boundaries of treatment and control stations.

Objective 2

Population estimates of rainbow-steelhead and spring chinook were made with the two and three pass removal method (Zippin 1958, Seber and Whale 1970). Station boundaries were blocked with seines prior to sampling. We used two or three electroshockers, working in conjunction beginning at the upper blocking seine and moving downriver to the lower seine, to collect fish. Two passes were made initially through each sampling station. Catch was recorded seprately for each pass. Rainbow-steelhead were also separated into two size groups approximately age 1 and age 2 and older in each stream.

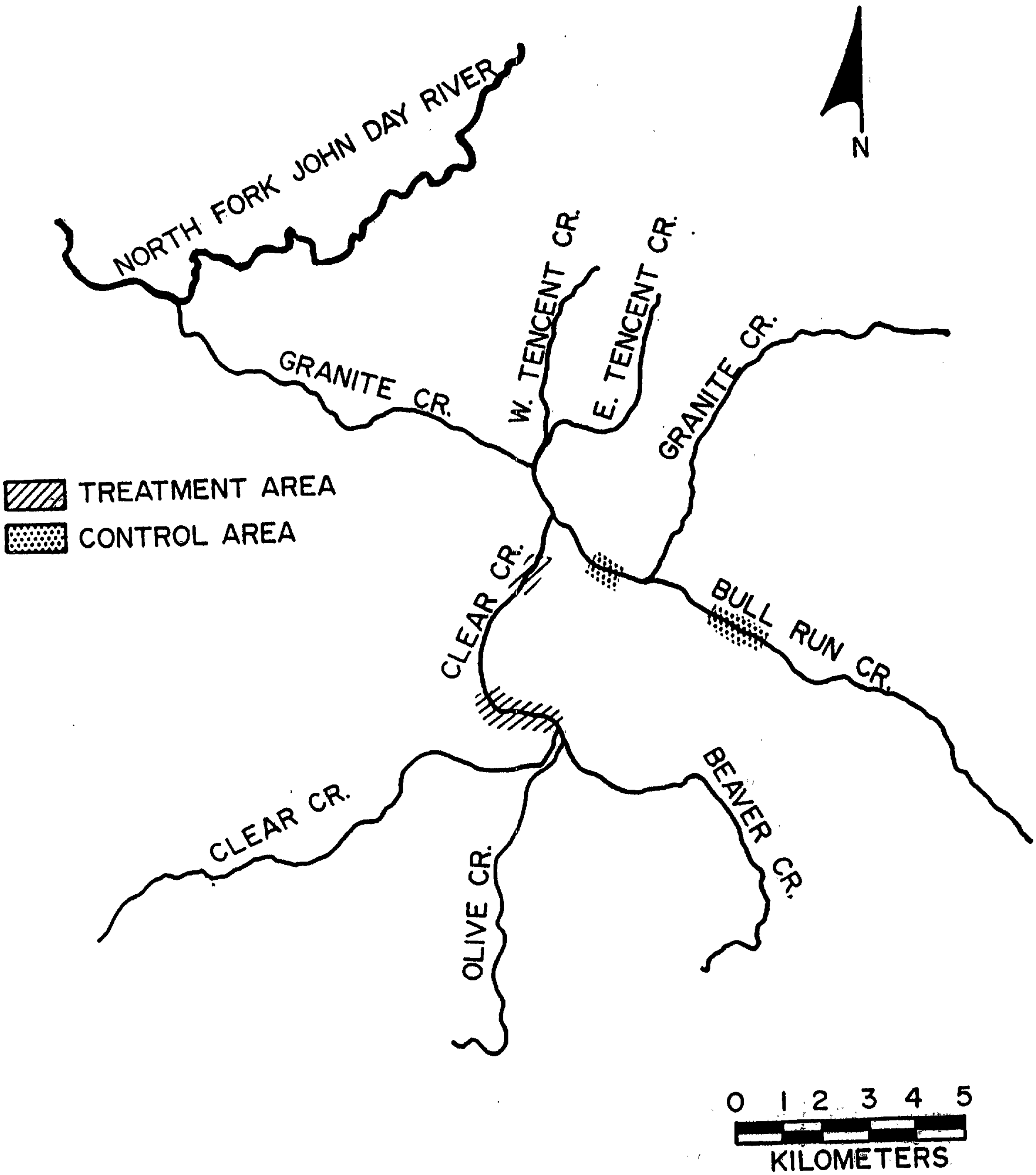

Fig. 4. Location of sampling areas in the Clear Creek study area.

Population estimates were made with the 2-catch method for chinook and for each if the two age groups of rainbow-steelhead. If confidence limits exceeded 25% of the population estimate of any group then a third pass was made through the sampling station and an estimate was made with the 3-catch method.

Objective 3

All rainbow-steelhead age 1 and older were measured to the nearest 1.0 mm fork length. All age 0 fish were measured at Deer and Clear creeks, but onlya subsample was measured in Camp Creek. A random sample of 40-50 chinook were measured to the nearest 1.0 mm fork length in each of the four Clear Creek study areas.

Objective 4

A random sample of scales was collected from approximately 50% of the age 1 and older rainbow-steelhead in each study area. Scales located directly above the lateral line just behind an imaginary line extending perpendicular from the lateral line to the distal point of attachment of the dorsal fin were transferred to numbered gummed cards.

Objective 5

We measured stream depth, stream width, station length, pool/riffle ratio, spawning gravel area, and cover to document physical changes as a result of habitat improvements.

Stream widths were measured at ten evenly spaced intervals within each sampling station that was larger than 31 m in length. At sampling stations less than 31m in length, widths were measured at evenly spaced intervals ranging from three to ten depending on the length of the sampling station.

Stream depths were measured at four evenly spaced intervals along each width measurement. Depth was recorded at intervals of one-eighth, three-eighths, five-eighths, and seven-eighths of the stream width.

Pool length of a station was the sum of the lengths of each individual pool in that station. Pools less than two thirds of the stream width were not measured. Lengths were measured along the thalweg. Area not classed as pools were considered riffles.

Spawning gravel area was estimated in each sampling station by measuring the surface area of gravel that appeared to be suitable for spawning. Suitable areas were areas of loosely compacted gravel in which the gravel was approximately 1 cm to 8 cm in diameter and in which water depth and velocity were judged adequate for spawning. Areas of gravel less than approximately 0.1 m^2 were not included.

Cover within each sampling station was classified as bank, riparian, boulder, surface turbulence, and weir cover types. The area of each cover type was estimated by measuring the water surface which we visually estimated was influenced by that cover type. Boulders less than 40 cm in diameter were not included as boulder cover.

We measured widths and depths of plunge pools formed behind weirs that were within station boundaries. Widths were measured at 1 and 2.5m intervals below the weir. Depths were measured at intervals one-eighth, three-eighths, five-eighths, and seven-eighths of the stream width.

The surface area of each sampling station was estimated by partitioning each station into a series of rectangles, each of which was bisected by one width mesurement. The length of each rectangle equalled the biseting width mesurement; the side of the rectangle equalled the distance between width mesurement for that station. The areas of all rectangles were summed to estimate the surface area of the sampling station.

The volume of water in each sampling station was estimated by taking a cross-section at each width measurement and dividing this into two triangles and three adjacent trapezoids using corresponding depth measurements as sectioning points. The areas of the triangles and trapezoids were summed then multiplied by the distance between width measurements for that station to give a volume of water corresponding to a rectangular segment. Volumes of all segments were then summed to give total water volume in a sampling station.

Objective 6

Photopoints were established in selected study reaches to graphically document changes in the stream because of habitat improvements and to show changes in the structures over time. Stakes that marked station boundaries were used to mark photopoints in Camp and Deer creeks. Photopoints in Clear Creek were referenced in the weirs.

RESULTS

Results are given in the following tables and figures.

Objective 2.

Table 2.1. Population estimates (N) of age 1 and older rainbow-steelhead in Deer Creek, July 1983.

Sampling station	Rainbow-steelhead [a] N (95% CL)	Fish/100m
Log weirs		
1	42 (42- 44)	183
2	--	--
3	87 (84- 90)	272
4	40 (40- 42)	182
5	61 (60- 64)	277
6	64 (64- 65)	267
7	69 (69- 70)	256
8	75 (71- 80)	326
9	53 (52- 54)	184
Rock weirs		
1	56 (55- 79)	181
2	87 (86- 90)	174
3	8 [b]	89
4	29 [b]	121
5	82 (82- 83)	178
Log deflectors		
1	26 (26- 27)	153
2	47 (45- 50)	247
3	21 (20- 25)	210
4	28 [b]	165
5	28 (25- 33)	165
6	27 (27- 29)	117
Boulder placements		
1	43 (43- 44)	287
2	39 (38- 41)	355
3	20 (20- 21)	167
4	38 (38- 40)	291
5	18 [b]	300
Control		
1	58 (56- 62)	118
2	59 (58- 60)	120
3	79 (78- 80)	161
4	58 (58- 59)	118
5	63 (62- 65)	129
6	61 (61- 73)	124

[a] *Does not include rainbow-steelhead less than 63mm in length.*
[b] *Confidence limits less than ±0.5.*

Table 2.2. Population estimates (N) of age 1 and older rainbow-steelhead in Camp and Slide creeks, August 1983.

Sampling station	Rainbow-steelhead [a] N (95% CL)	Fish/100m
Camp Cr.-treatment		
1	37 (36- 40)	74
2	50 (47- 55)	104
3	55 (54- 57)	110
4	46 (44- 49)	88
5	36 (36- 37)	78
6	44 (42- 50)	85
7	60 (59- 63)	118
8	71 (70- 74)	148
9	54 (52- 59)	126
10	71 (72- 72)	145
11	86 (84- 90)	179
12	108 (101-116)	225
13	41 (42- 44)	82
14	84 (83- 87)	156
15	73 (71- 77)	146
16	68 (64- 70)	131
Camp Cr.-control		
1	56 (56- 57)	114
2	52 (51- 54)	90
3	69 (67- 72)	130
4	74 (72- 79)	151
5	60 (59- 62)	125
6	76 (75- 78)	149
7	97 (96- 98)	194
8	71 (70- 72)	145
9	49 (49- 51)	100
10	68 (67- 71)	139
11	45 (44- 48)	92
12	67 (66- 70)	140
13	63 (61- 68)	119
14	93 (88-101)	190
15	83 (80- 88)	154
16	21 (20- 21)	49
Slide Cr.		
1	42 (41- 44)	70
2	34 (34- 36)	106
3	40 (39- 41)	63
4	19 (19- 20)	31
5	38 (37- 39)	52
6	11 [b]	22

[a] Does not include rainbow-steelhead less than 70 mm and 80 mm in fork length *in Camp and Slide creeks, respectively.*
[b] *Confidence limits were less than ±0.5.*

Table 2.3. Population estimates (N), of age 0 chinook and age 1+ and older rainbow-steelhead in each of four sections of Clear Creek, August 1983.

Sampling station	Rainbow-steelhead [a] N (95% CL)	Rainbow-steelhead [a] Fish/100m	Chinook N (95% CL)	Chinook Fish/100m
Upper Clear Cr.				
1	23 (22-25)	37	4 (4- 7)	6
2	15 (15-16)	33	1 [b]	2
3	26 (25-29)	60	14 (9-21)	33
4	13 (13-14)	35	11 (10-13)	30
5	41 (39-44)	56	9 (9-10)	12
6	29 (28-31)	76	6 [b]	16
Lower Clear Cr.				
1	19 (17-24)	34	29 (25-40)	52
2	13 (13-14)	22	46 (38-54)	78
3	12 [b]	27	31 (29-36)	70
4	14 [b]	33	32 (28-37)	76
5	16 (16-17)	42	32 (31-34)	84
6	15 (15-16)	36	20 (19-22)	48
Granite Cr.				
1	4 [b]	13	25 (24-28)	83
2	1 [b]	4	6 [b]	24
3	12 [b]	55	23 (21-26)	105
4	12 (11-15)	43	26 (26-27)	93
5	4 [b]	13	22 (21-24)	71
6	7 [b]	17	50 (50-52)	122
Bull Run Cr.				
1	11 (10-13)	35	26 (25-29)	84
2	11 [b]	35	69 (64-75)	223
3	13 (13-14)	46	26 [b]	93
4	9 [b]	24	34 [b]	92
5	10 (10-11)	48	23 (23-24)	110
6	10 (10-11)	31	25 (24-28)	78

[a] *Does not include rainbow-steelhead less than 81 mm in fork length.*
[b] *Confidence limits were less than ±0.5.*

Table 2.4. Mean densities (fish/100 m) of rainbow-steelhead in areas with different habitat improvement structures, Deer Creek, 1983.

Structure	Stations sampled	Mean density (fish/100 m)
Log weir	8	244
Rock weir	5	149
Log deflector	6	176
Boulder placement	5	280
Control	6	128

Table 2.5. Mean densities (fish/100 m) of juvenile rainbow-steelhead and spring chinook before (pre-treatment) and after (post-treatment) habitat improvements were completed on Clear Creek.

	Upper Clear Creek [a]		Lower Clear Creek	
	Rb/St	Chinook	Rb/St	Chinook
Pre-treatment				
1979	105	3	42	299
1980	51	0	35	91
1981	50	0	49	107
Post-treatment				
1983	52	17	33	70

[a] *Some habitat improvements were being constructed in 1980 and 1981.*

Table 2.6. Mean lengths of age 0 rainbow-steelehad in Camp and Slide creeks, August 1983.

Sampling area	Sample size	Fork length (mm)		
		Range	Mean	95% CI
Camp Creek (Treatment)	380	26-69	48	± 1
Camp Creek (Control)	319	30-68	50	± 1
Slide Creek (Control)	326	46-79	64	± 1

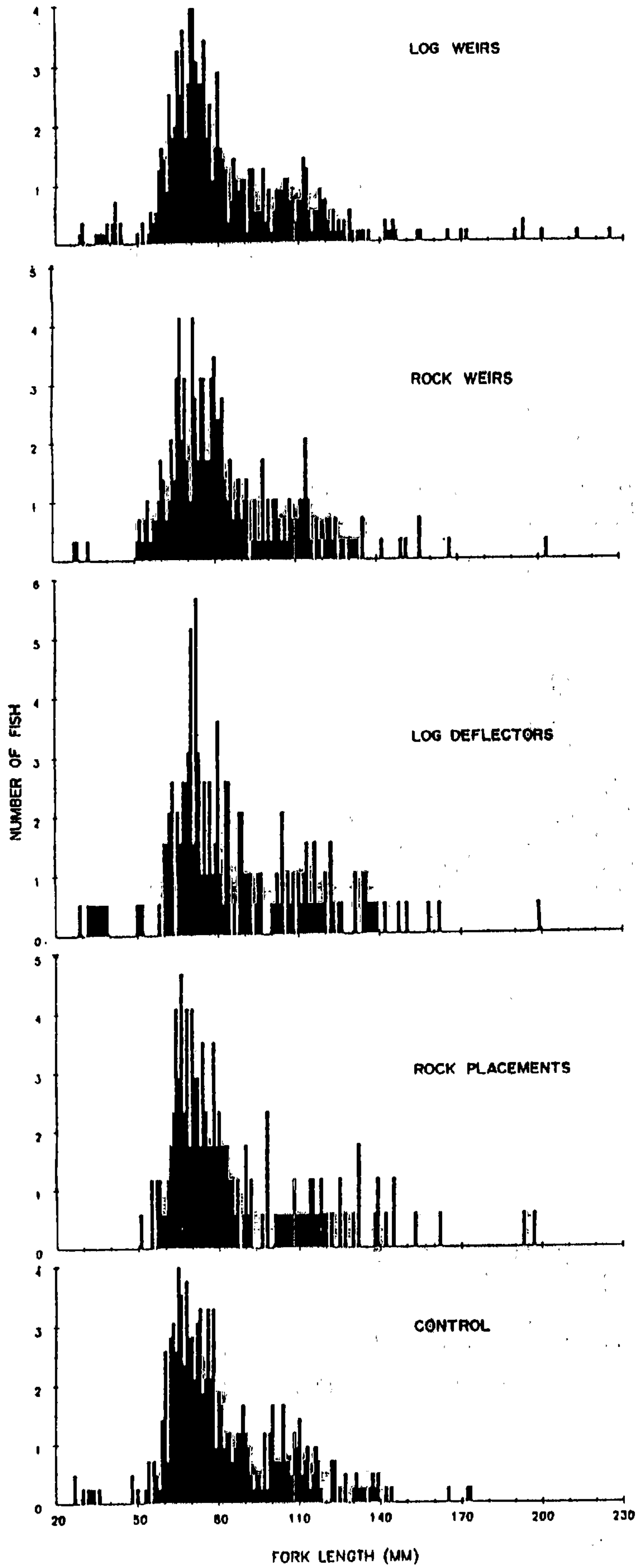

Fig. 2.1. length frequencies of age 0 and older rainbow-steelhead in Deer Creek, July, 1983.

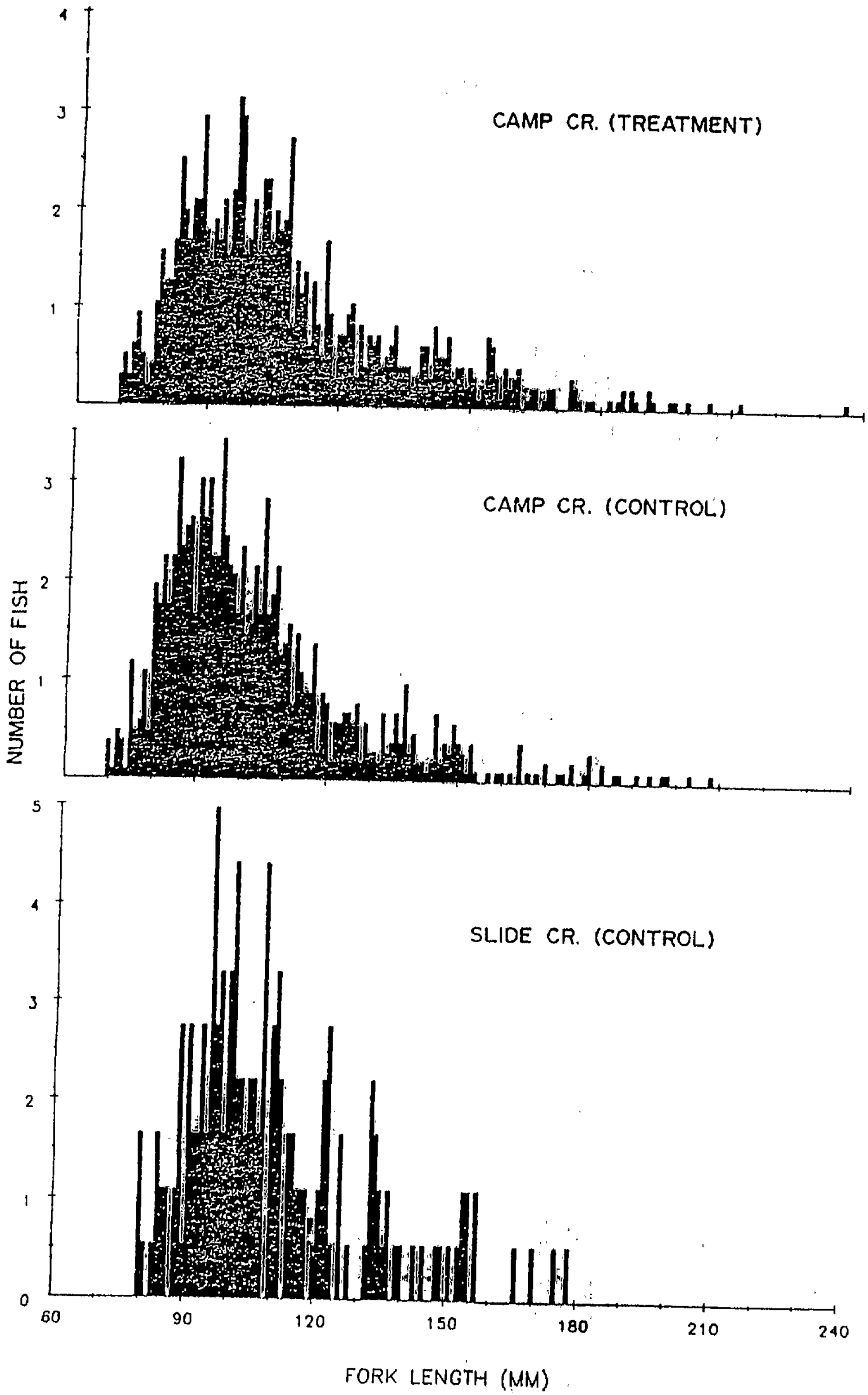

Fig. 2.2. Length frequencies of age 1 and older rainbow-steelhead in Camp Creek and in Slide Creek, August, 1983.

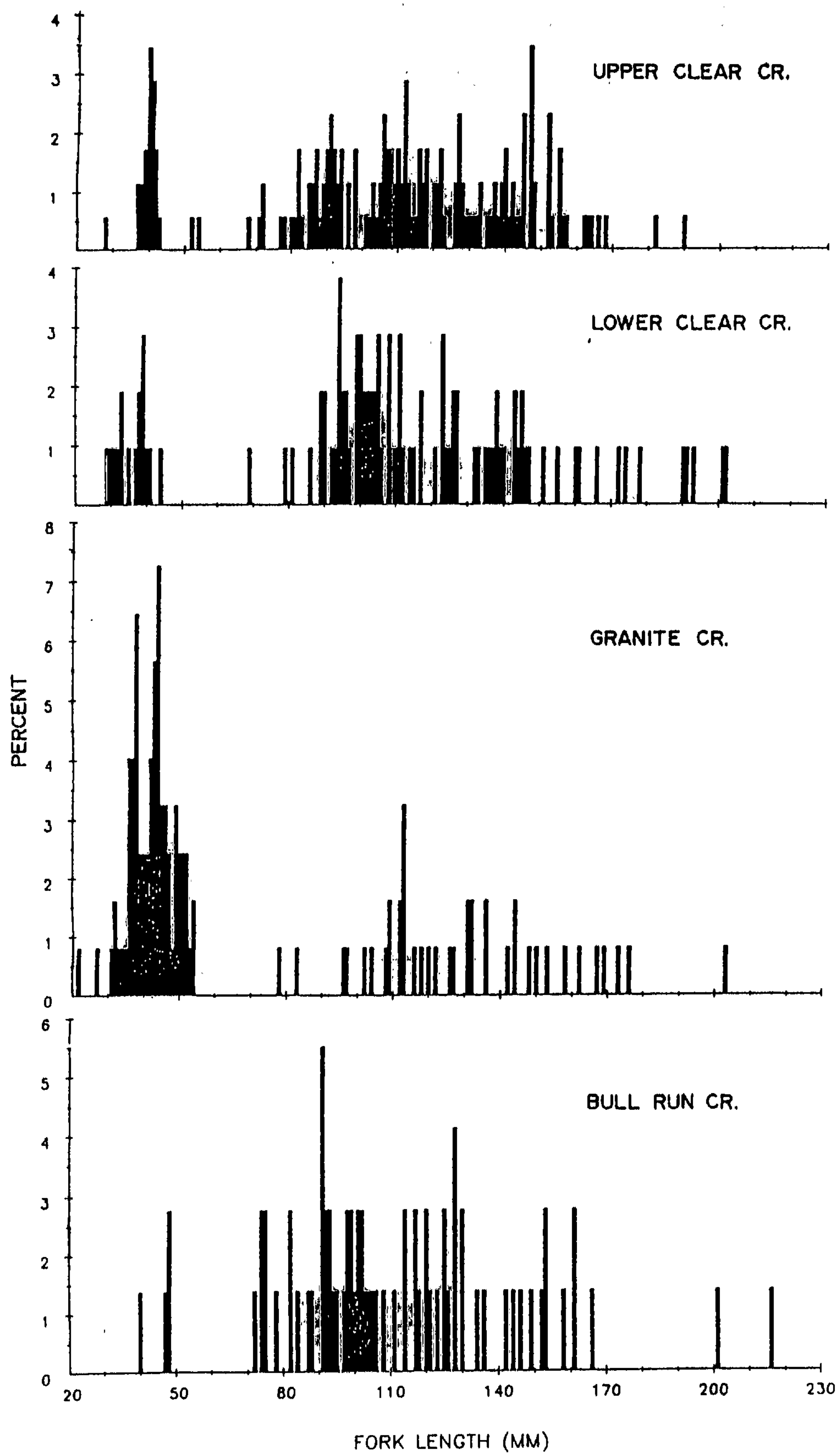

Fig. 2.3. Length frequency histogram of age 0 and older rainbow-steelhead in the Clear Creek Study area, August, 1983.

Table 2.7. Salmon redds counted in upper Clear Creek and in the historical index areas of Clear, Granite, and Bull Run creeks, 1978-81.

Year	Upper Clear Creek	Lower Clear Creek	Granite Creek	Bull Run Creek
1978	4	25	109	31
1979	2	28	86	16
1980	2	28	47	3
1981	2	45	68	7
1982	6	43	66	13
1983	2	4	40	2

Objective 5.

Table 5.1. Physical measurements in each of thirty-one sampling stations in Deer Creek, July 1983.

Sampling station	Length (m)	Surface area (m^2)	Volume (m^3)	Pool (m)	Cover (m^2)	Spawning gravel (m^2)
Log weirs						
1	23	113	30	12.2	10.2	27.0
2	36	--	--	--	--	--
3	32	202	51	7.9	15.0	71.6
4	22	123	40	7.9	14.8	32.5
5	22	129	38	9.8	11.0	2.8
6	24	118	31	14.6	4.7	0.7
7	27	186	30	3.9	10.3	20.9
8	23	138	42	20.4	10.5	0.0
9	28	154	27	11.3	7.0	0.0
Rock weirs						
1	31	155	27	9.1	2.0	32.3
2	50	290	42	4.3	16.7	47.6
3	9	49	7	0.0	0.3	10.7
4	24	176	21	0.0	0.5	21.3
5	46	254	26	2.7	4.3	47.8
Log deflectors						
1	17	80	16	7.3	1.2	1.1
2	19	141	33	8.5	2.7	32.8
3	10	53	12	6.4	5.0	0.3
4	17	96	17	6.7	0.7	8.1
5	17	86	13	12.2	12.4	0.0
6	23	150	14	0.0	2.8	21.0
Rock placements						
1	15	73	16	5.5	4.6	15.6
2	11	60	14	3.7	6.1	11.9
3	12	70	14	4.3	1.3	11.6
4	13	74	15	3.7	2.2	13.4
5	6	37	8	2.4	0.6	6.4
Control						
1	49	243	25	14.3	14.6	0.0
2	49	232	36	7.0	6.7	32.7
3	49	240	46	11.9	13.7	27.2
4	49	209	35	5.5	12.0	4.3
5	49	231	42	6.1	6.8	0.0
6	49	256	38	1.2	7.8	137.5

Table 5.2. Physical measurements in each of thirty-two sampling stations in Camp Creek in six stations in Slide Creek, August 1983.

Sampling station	Length (m)	Surface area (m^2)	Volume (m^3)	Pool (m)	Cover (m^2)	Sampling gravel (m^2)
Camp Cr.-Treatment						
1	50	127	13	18.0	4.2	0.0
2	48	126	12	15.2	2.1	0.0
3	50	156	19	21.0	3.3	0.0
4	52	191	16	18.6	1.6	0.0
5	46	136	14	11.3	4.9	0.7
6	52	235	24	11.6	2.7	0.0
7	51	181	26	8.6	6.4	4.7
8	48	285	36	21.2	6.1	0.0
9	43	255	33	16.5	5.7	0.0
10	49	264	29	18.3	3.5	0.0
11	48	172	20	0.0	2.1	0.0
12	48	521	98	48.2	29.5	13.4
13	50	306	30	3.3	0.5	0.0
14	54	420	43	0.0	2.6	0.0
15	50	421	48	1.8	4.3	0.0
16	52	400	74	22.0	4.9	0.0
Camp Cr.-Control						
1	49	109	11	20.3	1.4	1.1
2	58	110	12	32.3	7.9	7.6
3	53	171	20	18.3	3.3	0.0
4	49	216	19	1.5	3.3	0.0
5	48	279	22	0.0	1.2	0.0
6	51	302	27	5.5	2.9	0.6
7	50	305	27	17.4	6.0	0.0
8	49	216	26	24.1	10.1	0.0
9	49	254	23	7.3	2.8	0.0
10	49	202	20	5.8	1.9	0.0
11	49	216	17	6.7	1.1	0.0
12	48	208	22	12.2	1.5	0.0
13	53	298	30	6.4	1.1	0.0
14	49	308	48	24.1	5.6	5.6
15	54	496	49	0.0	3.9	3.9
16	43	301	34	0.0	0.7	0.0
Slide Cr.						
1	60	230	21	11.9	1.6	0.4
2	32	130	13	11.3	2.2	0.0
3	63	251	18	14.9	2.0	0.0
4	62	262	22	0.0	0.5	0.3
5	73	272	25	26.2	3.6	0.0
6	51	201	15	0.0	0.5	0.0

Table 5.3 Physical measurements in each of twenty-four sampling stations in the Clear Creek study area, August 1983.

Sampling station	Length (m)	Surface area (m^2)	Volume (m^2)	Pool (m)	Cover (m^2)	Spawning gravel (m^2)
Upper Clear Cr.						
1	62	382	95	33.5	6.8	76.7
2	46	300	50	21.3	2.7	53.2
3	43	280	64	41.2	5.8	7.0
4	37	266	52	14.3	4.5	3.5
5	73	462	97	9.1	4.0	149.1
6	38	309	106	35.4	4.7	22.3
Lower Clear Cr.						
1	56	549	94	14.6	3.1	0.6
2	59	479	112	18.3	2.0	18.1
3	44	451	84	15.2	7.0	22.3
4	42	427	73	15.9	5.3	13.1
5	38	365	81	25.3	1.4	93.7
6	42	352	60	9.8	2.7	0.0
Granite Cr.						
1	30	186	36	11.0	1.2	0.6
2	25	156	16	4.6	0.2	0.0
3	22	83	21	12.2	4.9	7.4
4	28	133	23	4.9	1.7	8.4
5	31	164	45	19.9	1.0	0.0
6	41	260	34	4.0	1.2	14.9
Bull Run Cr.						
1	31	115	19	0.0	0.6	0.0
2	31	119	21	3.1	1.6	0.0
3	28	115	18	3.4	1.9	0.3
4	37	124	21	0.0	0.4	0.0
5	21	69	11	8.2	1.8	0.0
6	32	117	16	4.3	0.3	0.0

STUDY CHANGES FOR 1984

1. Boundaries of some samplign stations were not located at natural breaks in Camp Creek in 1983. Boundaries of these stations will be moved to riffles or other breaks in 1984.
2. Ten width measurements will be taken at all sampling stations regardless of station length.
3. A modified Humphrey scoop trap in combination with a weir will be used to estimate the actual number of smolts that migrate from Camp Creek each spring.
4. Steel fenceposts will be used to permanently mark photopoints. Compass bearings will be used to orient the camera over the post each year. A number will be included in each picture to reference the location of the photopoint.

REFERENCES CITED

Seber, G.A. and J.F. Whale. 1970. The removal method for two and three samples. Biometric, 26:393-400.

Zippin, C. 1958. The removal method of poulation estimation. The Jounral of Wildlife Management, 22:82-90.

DEVELOP BROODSTOCK OF NATIVE SNAKE RIVER COHO SALMON

ANNUAL REPORT, 1983

By

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Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP12868
Project No. 83-441
Project Officer: Larry Everson

ABSTRACT

The objective of this program is to develop a brood stock of native Snake River coho salmon for use in rehabilitating this species in the Grande Ronde River system. To initiate collection of brood stock, an existing fish trap in the Ice Harbor Dam south shore fish ladder was modified to collect coho. Attempts to trap coho began on September 3, and were terminated on October 3, 1983. Although 225 adult and almost 300 jack coho were counted as they entered the south shore ladder, only one adult was collected in the trap. Fate of all remaining coho is unknown.

INTRODUCTION

Historically the Grande Ronde River system was the only coho producing tributary to the Snake River. In recent years these runs have become severely depleted. In an attempt to reverse this downward trend a Coho Brood Stock Development Program was undertaken in 1983 by the Oregon Department of Fish and Wildlife (ODFW). The project was funded by the Bonneville Power Administration (BPA) under the Northwest Power Planning Council's Fish and Wildlife Program. The primary project objective is to develop a brood stock of native Snake River coho salmon for use in rehabilitating this species in the Grande Ronde River system.

Adult coho salmon were to be trapped at Ice Harbor Dam (Rm 9.7) on the lower Snake River, transported to the ODFW Wallowa Fish Hatchery, and spawned. We hoped to obtain about 120,000 eggs during the fall of 1983, thereby producing 100,000 smolts for release at Wallowa Hatchery in the spring of 1985. Adults returning from this release would then be trapped and spawned at the hatchery.

BACKGROUND

Coho salmon were once relatively abundant in the Snake River system, a major salmon-producing tributary of the Columbia River. The historic major production area in the Snake was the Grande Ronde River system in northeast Oregon. Snake River coho have been adversely impacted by hydroelectric dams, overfishing, and tributary watershed problems; and returns to the river, based on counts at main Snake dams have averaged only 163 fish/year for the past three years.

Much of the original coho production area in the Grande Ronde system remains intact. However, due to the low level of the remnant coho run and continued losses at main Snake and Columbia dams, it is unlikely that the population can recover unless it is supplemented with hatchery fish.

Although surplus numbers of coho salmon return to hatcheries in the lower Columbia River, these areas are several hundred miles downstream from the Grande Ronde River. It is questionable, therefore, that these fish have the proper attributes to do well in a river system several hundred miles from their area of origin. The need to migrate upstream far beyond their present production area may alone impair their ability to return, spawn, and perpetuate themselves in the Grande Ronde River system. Mixing of lower Columbia River coho stocks with native Grande Ronde River stocks could result in progency who developed downriver life history characteristics, consequently causing irreparable harm to Grande Ronde River stocks.

Since known Snake River coho stocks were available at Ice Harbor Dam, we believed the best course was to develop a brood stock of native Snake River coho salmon. Therefore, collection of coho was attempted in the south shore fish ladder of Ice Harbor Dam. Official fish counts were done at the counting station in the lower end of the fish ladder, while the fish trap was located near the top of the fish ladder just preceding the exit into the forebay.

METHODS AND MATERIALS

A fish trap has been operated at Ice Harbor Dam during the past six years to trap fall chinook for use in the Snake River fall chinook egg bank program and we felt the trap could also be used for collecting adult coho salmon in 1983. Several modifications were made to better facilitate collection, identification and separation of coho from fall chinook salmon and steelhead. The modifications were: 1) construction and installation of a separate holding tank for coho, and 2) provisions for underwater, close range (3 inch to 3 feet) side viewing of fish in the trap. Previously, all viewing had been from overhead at a distance of 4 to 8 feet.

The trap was installed in the south shore fish ladder on September 3, 1983, and manned by University of Idaho (U of I) personnel for between 11 and 13 hours daily (usually 0630-1930) for 28-1/2 days of the 31 day trapping period. Due to unavailability of a transport truck, the trap was not operated on September 19, 20, and half of the 21st. When not in operation all fish were allowed to pass through the trap and continue upriver. All coho which entered the trap were to be collected and transported to Wallowa Fish Hatchery.

RESULTS

During the trapping period, 225 coho adults and almost 300 coho jacks were counted by Corps of Engineers fish counters as they ascended the south shore fish ladder. However, only one coho was subsequently trapped at the top of the ladder. This fish, a female was captured on October 1, transported to Wallowa Hatchery on October 2 and released into the Wallowa River on November 20 to spawn in the wild. A similar, but hot as pronounced, discrepancy occurred in the chinook and steelhead counts. Of the 1,665 fall chinook and 50,637 steelhead counted as they ascended the ladder, only 1,533 fall chinook and 44,536 steelhead were counted through the trap.

DISCUSSION

Our primary concern is with the fate of coho which were observed at the counting station in the lower end of the south shore fish ladder (225 adults and almost 300 jacks) but were not observed passing the trap. Although we cannot specifically account for the discrepancies, several explanations, individually or in combination, are possible.

1. Official fish counts at the counting station were based on different adult/jack criteria than was used by UofI personnel operating the trap. At the counting station, any fish less than 22 inches in length was considered to be a jack, while at the trap any fish less than 25 inches was considered a jack. Only jacks with adipose fin clips (hatchery fish) were trapped, all others were allowed to pass through the trap and continue upriver. If a substantial number of coho were in the 22.0 to 24.9 inch size range, these fish would have been classified as adults in the official count but would have been allowed to pass through the trap, if they were misidentified as non-adipose fin-clipped jack fall chinook. Such count discrepancies did exist between official and trap counts of fall chinook with 37.4% and 59.6%, respectively, of the chinook being classified as jacks. Additionally, coho caught in the 1983 Columbia River gillnet fishery were notably smaller in 1983 than in previous years. Coho averaged 5.7 pounds and approximately 21.7-22.4 inches in 1983 as opposed to 7.9 pounds and 24.8-25.6 inches for 1978-82. (B. R. Bohn, personal communications, February 1984).

2. University of Idaho personnel (usually graduate students) may have misidentified coho as steelhead or jack fall chinook and, therefore, let them pass through the trap.

3. The official fish counters may have misidentified steelhead or chinook as coho.

4. Coho may have held in the fish ladder during the day and migrated through the trap after trapping ceased each day.

Although there were count discrepancies for steelhead and fall chinook between official counts and trap counts, this may be due to the longer daily official counts (0500-2100, 16 hours) as opposed to the trap counts (0630-1930, 13 hours) or the tendency of trapping activities to hinder fish passage and, therefore, result in fish migrating through the trap after trapping ceased each day.

Parts of eight days were spent on-site by ODFW personnel; however, no counting or trapping problems were observed.

CONCLUSIONS

There is no clear concensus as to the reason(s) for coho counting and trapping discrepancies. The ladder and trapping operation appears to work well for chinook and steelhead, but there is a large discrepancy in the coho count. Since this was the first attempt to trap coho at Ice Harbor Dam, we may need to further document coho behavior in the fish ladder before we solve the problem. Questions which may need to be answered are: 1) Do coho hold in the ladder? If so, for how long; hours? days?, 2) Do coho back out of the fish ladder at night? 3) Do coho pas through the trap after daily trapping activities cease? and 4) How does the presence of an obstruction in the ladder (i.e., a trap) affect coho upriver migration? Some of these questions may be easily addressed, while others would require extensive study.

Questions still seem to exist regarding proper identification of coho. This may be resolved by having counting and trapping personnel observe coho passage over lower Columbia River dams prior to arrival of coho at Ice Harbor Dam. Another aid in identification may be to install lighting in the trapping facility so that the conditions more closely approximate those of the counting station.

Installation of a finger weir on the slot at the lower end of the pool directly downstream from the trap may also help stop fish from dropping back down the ladder.

Although numerous problems were encountered in our initial attempts to obtain coho brood stock at Ice Harbor Dam in 1983, minor modifications and experience should result in a marked program improvement in 1984. We recommend continuing the program for at least one more year.

SUMMARY OF EXPENDITURES

Personal Services		
Salaries		$1,741.84
Other personal expenses (OPE @ 31.8%)		553.36
	TOTAL	$2,295.10
Services and Supplies		
Meals and lodging (In-state)		$ 176.00
Meals and lodging (Regional)		10.00
Mileage (1/2 ton truck)		342.64
Field supplies		13.84
	TOTAL	$ 542.46
Overhead (@ 21.5%)		$ 610.08
Capital Outlay		
Field equipment (trap modifications)		$5,000.00[1]
	TOTAL	$5,000.00
TOTAL		$8,447.64

1/ Estimated. University of Idaho has not submitted a bill for the trap modification.

APPENDIX F

Summary statistics for log-Pearson Type III frequency analysis for Trout Creek below Amity Creek, 1966-1978.

$\Sigma X = 30.0310$		$N = 12$
$\Sigma X^2 = 80.$[illegible]618		$X = 2.5026$
$\Sigma X^3 = 226.5951$		$S = 0.6880$
		$G = 0$

Exceedance probability P	Pearson Type III deviate K	Flow rate (cfs)
0.95	-1.64485	24
0.50	0	318
0.10	1.28155	2423

Reference: U.S. Water Resources Council. 1976. Guidelines for determining flood flow frequency. Bulletin No. 17 of the Hydrology Committee.

APPENDIX G

Summary statistics for log-Pearson Type III frequency analysis for Camas Creek near Ukiah, Oregon, 1932-1981.

$\Sigma X = 150.3161$	$N = 50$
$\Sigma X^2 = 454.2151$	$X = 3.0063$
$\Sigma X^3 = 1379.6625$	$S = 0.2174$
	$G = 0.448$

Exceedance probability P	Pearson Type III deviate K	Flow rate (cfs)
0.95	-1.50729	477
0.50	-0.07476	977
0.10	1.31990	1965

Reference: U.S. Water Resources Council. 1976. Guidelines for determining flood flow frequency. Bulletin No. 17 of the Hydrology Committee.

APPENDIX H

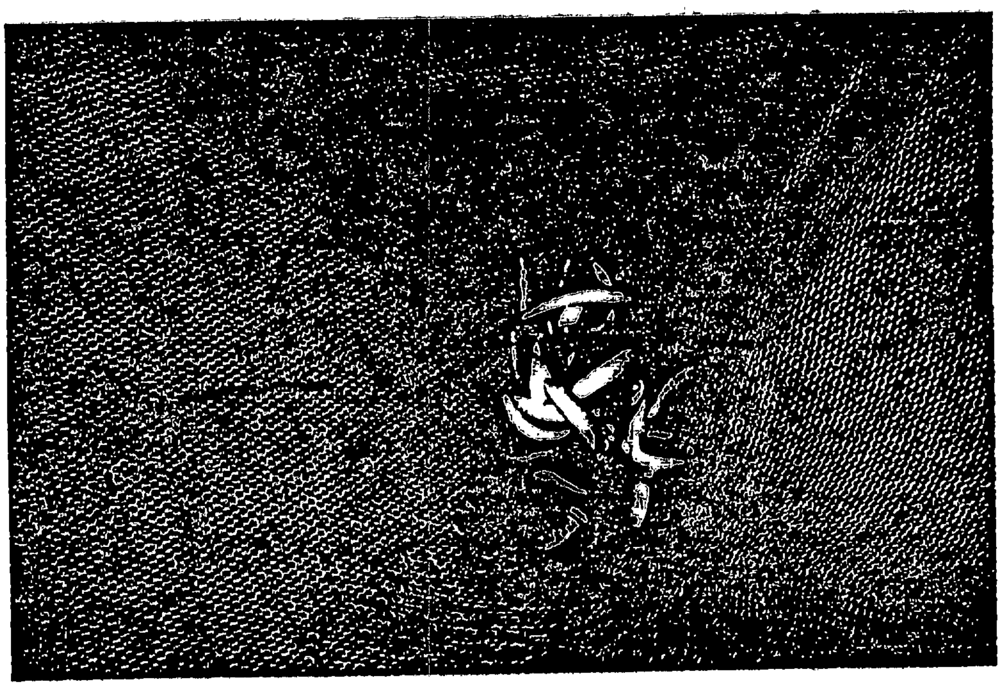
Summary statistics for log-Pearson Type III frequency analysis for North Fork John Day River at Monument, Oregon, 1925-1981.

$\leq X$	=	223.4938	N = 57
$\leq X^2$	=	879.8432	X = 3.92094
$\leq X^3$	=	3477.2747	S = 0.2513
			G = -0.320

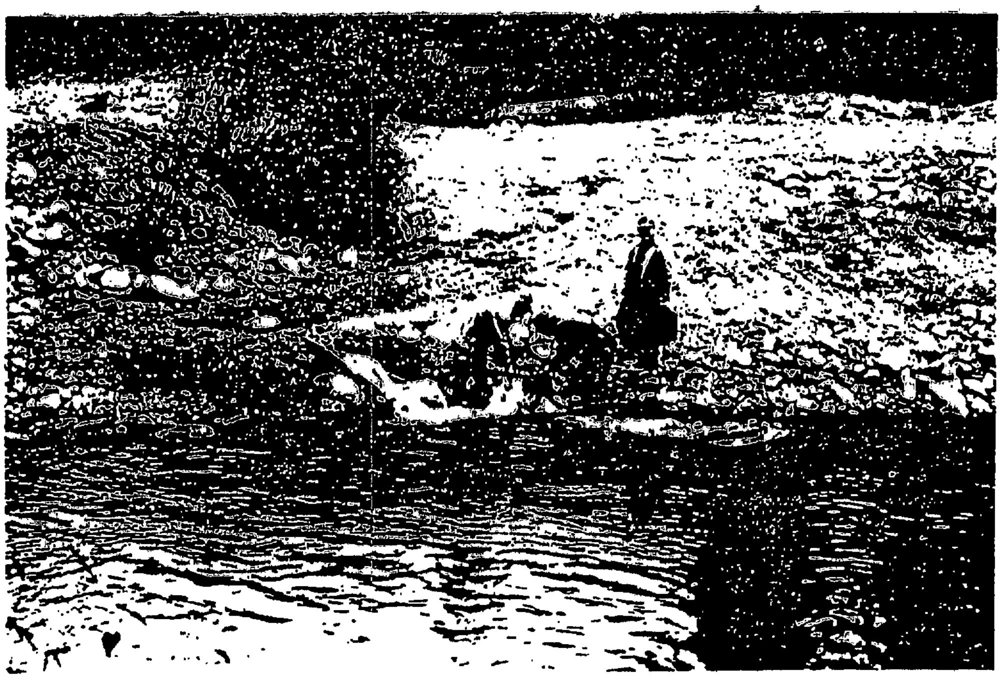
Exceedance probability P	Pearson Type III deviate K	Flow rate (cfs)
0.95	-1.72562	3,071
0.50	0.04993	8,580
0.10	1.24516	17,134

Reference: U.S. Water Resources Council. 1976. Guidelines fordetermining flood flow frequency. Bulletin No. 17 of the Hydrology Committee.

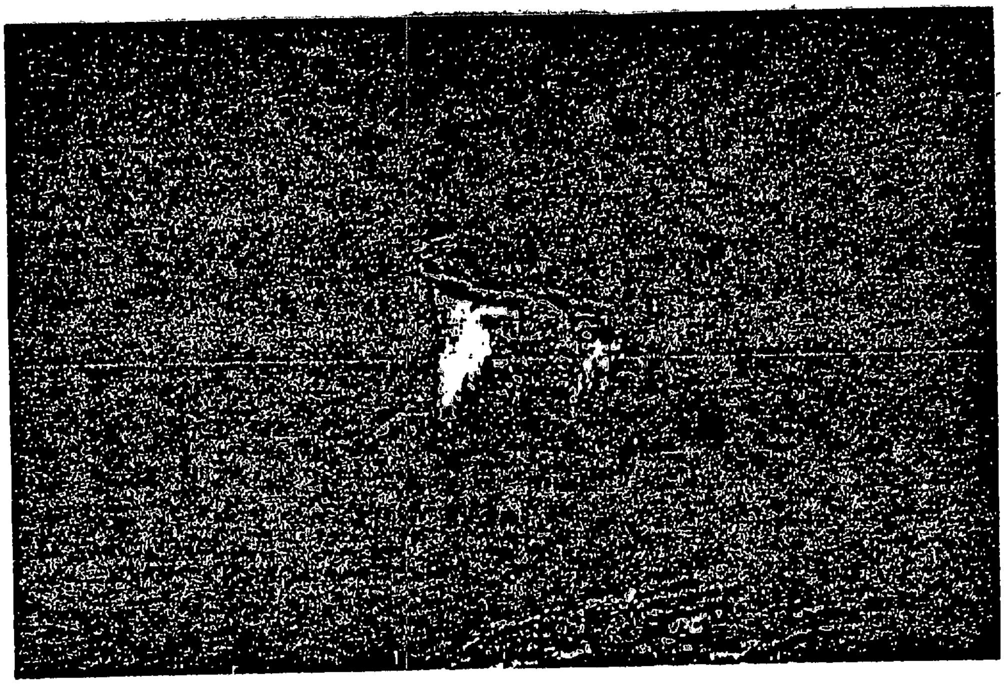
A fifty-foot seine was used to sample juvenile Salmon in the side channel pools.



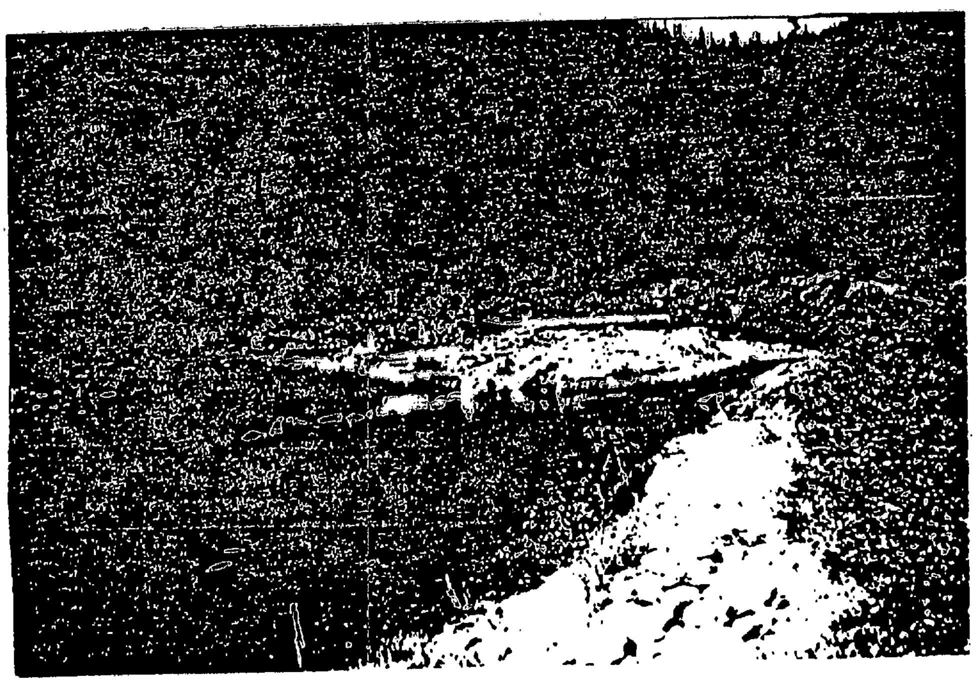
Forty juvenile Salmon seined in Side Channel 16.



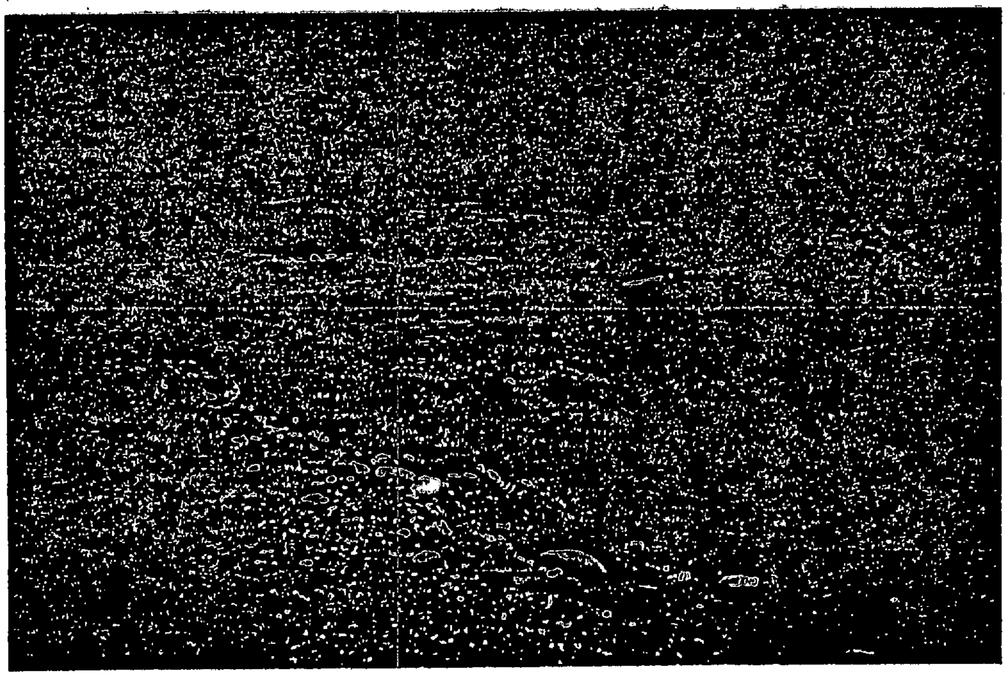
The captured Salmon were counted and released in the main river so another seine pass could be made to estimate the sample area population.



Main stem of the North Fork John Day River is on the left and the lower end of Side Channel 18 is on the right.



The entrance to Side Channel 17 after construction.



The entrance to Side Channel 16
prior to construction.

Opening Side Channel 16. The
stream cleared up within an hour.

CAMP CREEK HABITAT IMPROVEMENT

FINAL REPORT, 1982

By

Brady Green, Fishery Biologist
Malheur National Forest
John Day, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP39801
Project No. 82-9
Project Officer: Larry Everson

SUMMARY

During the summer of 1982, 128 single log weirs were constructed with BPA funding by the USDA Forest Service, Malheur National Forest in Camp Creek. The primary objective was to increase pool area in Camp Creek, thereby increasing the juvenile rearing capacity for summer steelhead trout and spring chinook salmon. In addition, construction of two miles of fence to accelerate riparian recovery and reduce summer water temperatures began and will be completed during the summer of 1983.

Estimated annual steelhead smolt production resulting from the project is 10,240 smolts, with a total annual benefit of $35,000. Also, there will be additional, but unknown, chinook salmon smolt increases which are not included in project benefits.

DESCRIPTION OF PROJECT AREA

Camp Creek supports the largest spawning run (344 adults) of summer steelhead in the Middle Fork John Day River and is located within the Long Creek Ranger District (Fig. 1). In addition, the lower six miles of Camp Creek provide juvenile rearing habitat for an undetermined number of spring chinook which migrate upstream from the Middle Fork to avoid warm summer water temperatures.

Stream survey assessments indicated that the stream channel was predominently riffle habitat characterized by gravel-rubble substrate, with the mean surface area in pool habitat being 33 percent. The stream was lacking habitat capable of supporting steelhead age 1+ to 2+ juveniles prior to smolting.

The mainstem of Camp Creek flows through a stringer meadow in the upper portion of the project area (Sections 7 and 8, Fig. 1), then flows through a narrow, steep-sided canyon eventually opening into a second set of stringer meadows (Sections 1-5, Fig. 1). The meadows are primarily grass with lodgepole pine and alder, while the canyon areas contain primarily mixed conifers, western larch, and alder. Some decadent black cottonwood are also found in the lower reaches of the project area.

DESCRIPTION OF ACTIVITIES

This project required five contracts for completion. These included: equipment rental agreements for four separate backhoes with operators, a contract to cut and deliver logs, a contract to haul riprap, and a contract to haul and deliver sakcrete. Along with each backhoe, a project crew consisting of four members was used to construct the log weirs.

Weir sites were selected beforehand, using a combination of hydrologic and fisheries criteria. Weirs were generally put in a series of five, which was considered to provide the optimum habitat for a typical stream reach. The weirs create high quality, self-cleaning pools ideal for rearing juveniles. These pools provide cover primarily through surface turbulence and depth. An added benefit of the pools is the additional spawning habitat created at the tail of each pool.

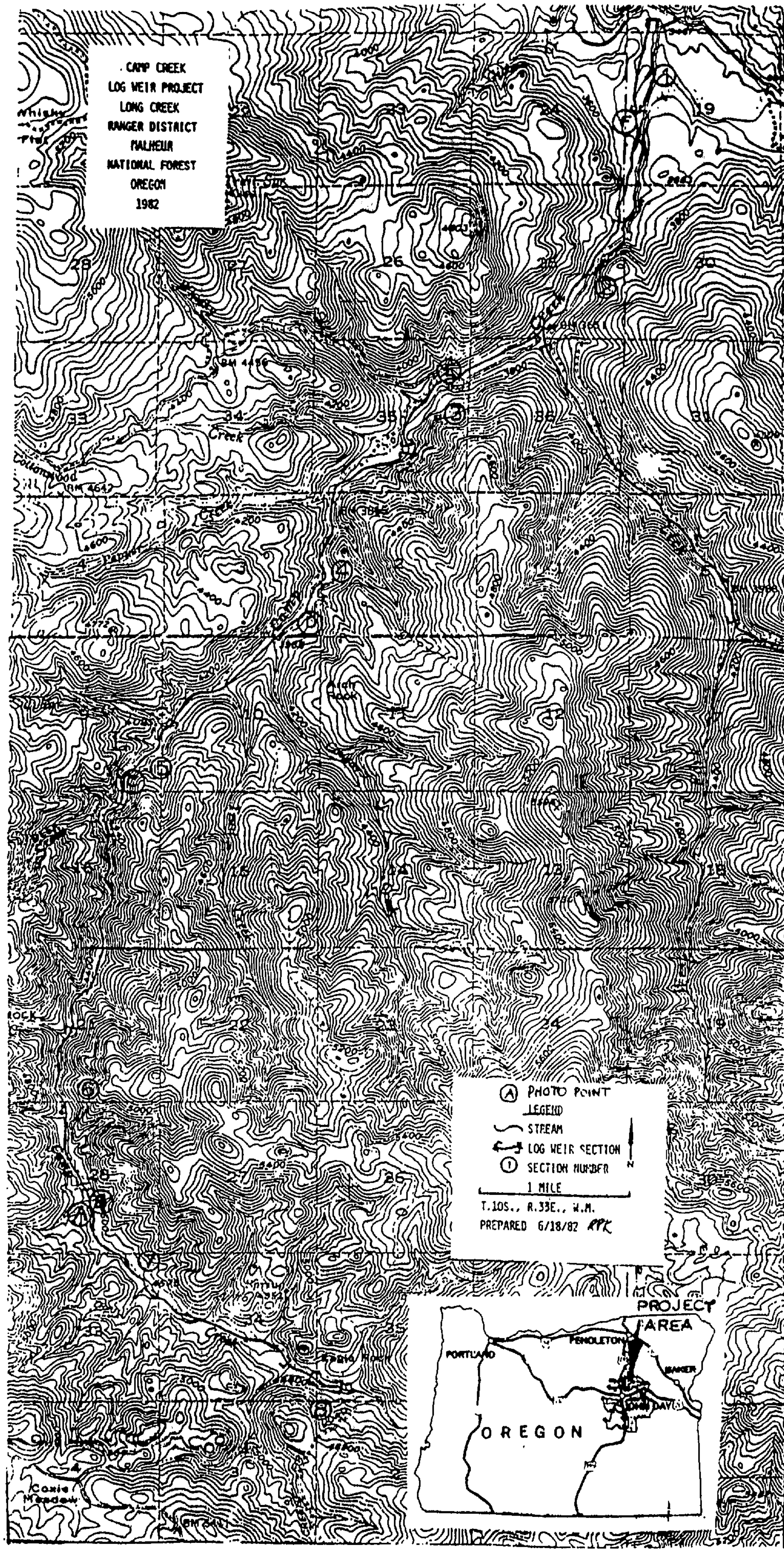

CAMP CREEK
LOG WEIR PROJECT
LONG CREEK
RANGER DISTRICT
MALHEUR
NATIONAL FOREST
OREGON
1982
PHOTO POINT
LEGEND
STREAM
LOG WEIR SECTION
SECTION NUMBER
1 MILE
T.10S., R.33E., W.M.
PREPARED 6/18/82 RPK
N
PROJECT
AREA
PORTLAND
PENDLETON
BAKER
OREGON

Figure 1.

All disturbed areas were seeded with grasses to speed up the recovery process.

The fence construction contract began this past fall but will not be completed until next summer due to contractual and weather problems.

Oregon Department of Fish and Wildlife is conducting a monitoring program on Camp Creek, financed by BPA, to determine changes in abundance of steelhead and chinook due to installation of log weirs and contrast fisheries benefits with costs of construction and maintenance.

ECONOMIC ANALYSIS

Project Costs:

a.	Manpower	21,500
b.	Backhoe contracts	15,000
c.	Supplies:	
	Hardware cloth	3,500
	Filter Cloth	2,000
	Sackcrete	14,000
	Rebar	800
d.	Riprap contract	1,300
e.	Misc. (tools, materials, rentals)	11,500
f.	Total cost of weirs (128 weirs @ approx. $544/weir)	69,600
g.	Fence cost: (2 mi. fence @ $2,500/mi.)	5,000 1/
h.	Rehabilitation (seeding, etc.)	1,400
i.	Total project cost	76,000

Project Benefits:

a. It is estimated that this project will result in an increased steelhead annual smolt production of 10,240 2/ with additional salmon smolt increases unknown and not included in project benefits.

1/ Partially constructed; will be completed in summer of 1983.

2/ Based on estimates for smolt habitat capability index, Columbia River Basin streams, USDA Forest Service.

b. Total adult steelhead production is estimated to be 410 fish (4 percent smolt/adult survival).

c. Adults harvested by inland sport and commercial fisheries is 245 fish (60 percent harvest).

d. Inland sport fisheries harvest equals 201 fish, which equals 844 angler days or 281 recreation visitor days (RVD); value of a steelhed RVD is $56.55; annual inland sport fisheries benefit is $15,913.

e. Commercial fisheries harvest is 44 fish; value of a steelhead caught commercially is $21.81; annual commercial fisheries benefit is $708.[3/]

f. Total estimated annual steelhead benefit is $16,621.

3/ Based on estimates for escaping Columbia River steelhead trout in "Net Economic Values for Salmon and Steelhead from the Columbia River System" by Philip A. Meyer, NOAA Tech. memo, NMFS F/NWR-3, 1982.

NARRATIVE

Camp Creek Pre and Post Treatment
Photographs of Representative Sites

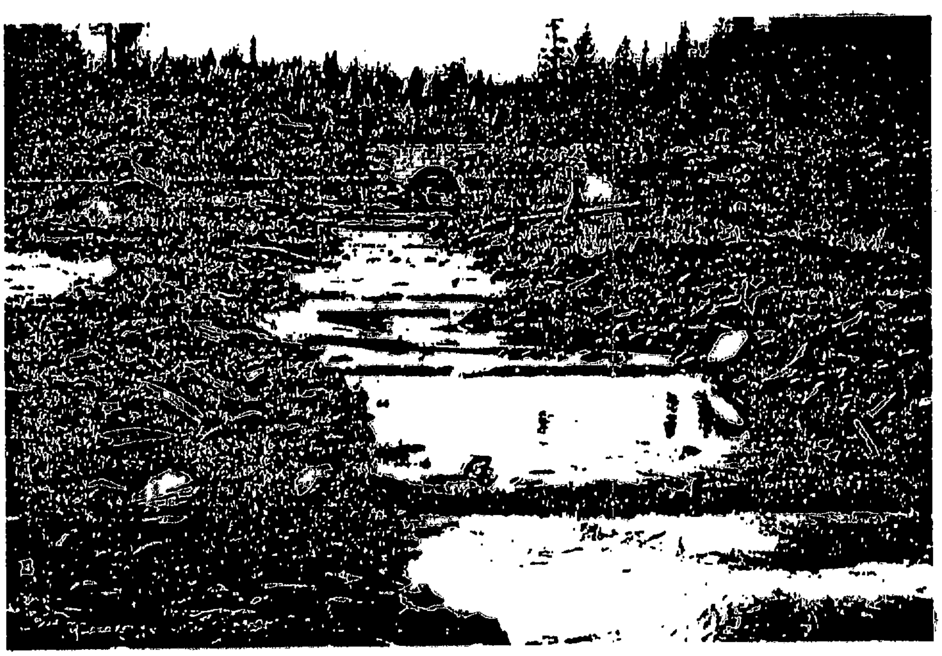
Fig.1 Map #		
A	A-1	Before: Looking upstream, log weir site above "Big Culvert," confluence of FS Road 3645 and 36, T.11S., R.32E., Section 28 (Log weir Section 7) (8/82).
	A-2	After: Same location as A-1 (10/82).
B	B-1	Before: Looking downstream, log weir site below "Big Culvert," confluence of FS Road 3645 and 36, T.11S., R.32E., Section 28 (Log weir Section 7) (8/82).
	B-2	After: Same location as B-1 looking downstream (10/82).
	B-3	After: Looking upstream (10/82).
C	C-1	Before: Looking upstream, log weir site below confluence of Deep Creek, T.11S., R.32E., Section 9 (Log weir Section 5) (9/82).
	C-2	After: Same location as C-1 (10/82).
D	D-1	Before: Looking upstream, log weir site above bridge on FS Road 3650, below confluence of Cougar Creek, T.11S., R.32E., Section 3 (Log weir Section 4) (8/82).
	D-2	After: Same location as D-1 (10/82).
E	E-1	Before: Looking upstream, log weir site above bridge on FS Road 36, below confluence of Whiskey Creek; T.10S., R.32E., Section 35 (Log weir Section 3) (8/82).
	E-2	After: Same location as E-1 (10/82).
F	F-1	Before: Looking downstream, log weir site below bridge on FS Road 3690 (Kahler Butte Road), T.10S., R.33E., Section 19 (Log weir Section 1) (8/82).
	F-2	After: Same location as F-1 looking downstream (10/82).
	F-3	After: Looking upstream (10/82)

A-1: Before, looking upstream
(8/82)

A-2: After, looking upstream
(10/82)

B-1: Before, looking downstream
(8/82)

B-2: After, looking downstream
(10/82)



B-3: After, looking upstream
(10/82)

C-1: Before, looking upstream
(9/82)

C-2: After, looking upstream

(10/82)

D-1: Before, looking upstrea
(8/82)

D-2: After, looking upstream
(10/82)

E-1: Before: looking upstream

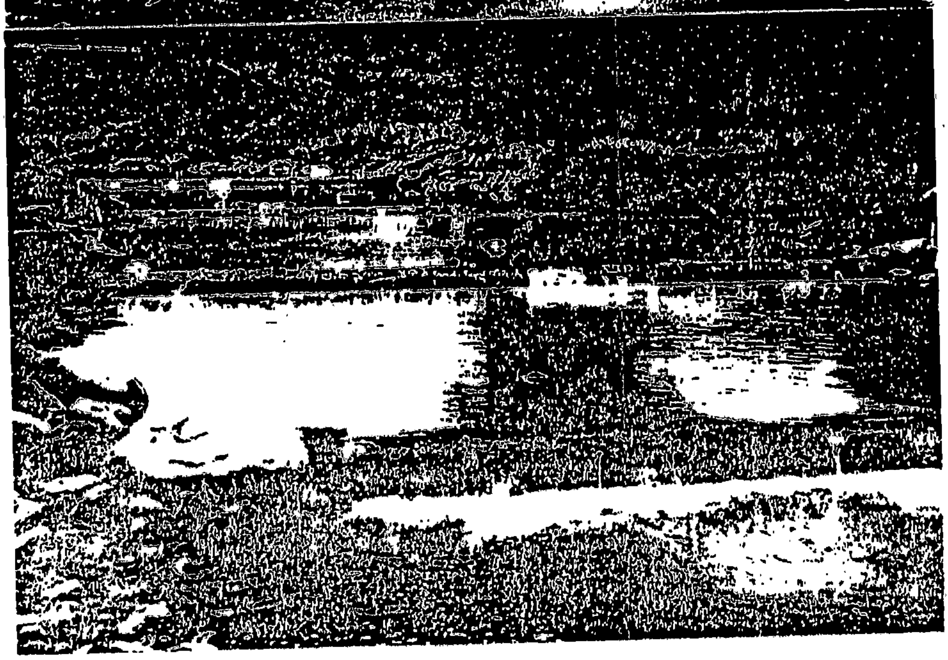
(8/82)

E-2: After, looking upstream

(10/82)

F-1: Before, looking downstream
(8/82)

F-2: After, looking downstream
(10/82)



F-3: After, looking upstream

DEER CREEK HABITAT IMPROVEMENT

ANNUAL REPORT, 1982

By

Ron Wiley, Fishery Biologist
Bureau of Land Management
Burns, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP39801
Project No. 82-9
Project Officer: Larry Everson

EXECUTIVE SUMMARY

The Deer Creek Summer Steelhead Habitat Improvement Project is a joint venture involving the Bonneville Power Administration (BPA), Burns District of the Bureau of Land Management (BLM), and the Oregon Department of Fish and Wildlife (ODF&W). The project involves upgrading summer steelhead spawning and rearing habitat in the BLM administered portion of Deer Creek. Deer Creek is a tributary of the South Fork of the John Day River and is the single most important and extensive summer steelhead spawning area on BLM administered lands in the South Fork drainage providing approximately 87% of the total accesible summer steelhead habitat found on these lands. Aquatic habitat ranges in quality from poor in the lower 0.25 miles to fair in the upper 2.65 miles. Major limiting factors are excessive water velocities, lack of pool area, and lack of suitable spawning gravels. Smolt production in this reach is approximately one-fourth to one-half that which occurs upstream where the gradient is lesser resulting in better habitat conditions. The difference can be directely traced to the limiting factors listed previously.

Overall goals of the subject project were to increase both the spawning and rearing capacity of the stream. In order to accomplish these goals three basic alterations in the stream had to be made, reductions in water velocities, increased pool area, and increased spawning area. The methods chosen to accomplish these tasks included log weirs, single and double log current deflectors, boulder weirs, and individual boulder placement. With the exception of boulder weirs, each of these techniques have proven successful in Deer Creek and adjacent streams in the drainage. Briefly, each of these slow water velocities thus allowing the deposition of gravel as well as providing resting and escape cover. In addition, water flowing over the log or boulder scours out a pool downstream providing rearing area for juvenile fish and acting to a certain degree to lower water temperatures. In all 10 log weirs, 3 boulder weirs, 4 double and 3 single log current deflectors, 2 log cutbank protectors, and 100 individual boulders were either constructed or placed in the stream. A variety of configurations were employed so as to adapt each series of improvements to the individual site characteristics thus obtaining maximum benefits. Structures extending the entire width of the stream were notched to allow upstream passage of juvenile fish. Disturbed areas were returned to natural contours and reseeded following cessation of construction activities.

The improvements can be expected to trap spawning gravel in the following amounts: log and boulder weirs - 55 sq. yds., double log deflectors - 25 sq. yds., single log deflectors - 13 sq. yds.. and boulders - 3 sq. yds. Based on observations of spawning activity by summer steelhead in this stream it was assumed that each additional 20 sq. yds. of suitable spawning gravel will produce one redd. Using this assumption it was calculated that a total of 38 additional spawning pairs would use these improved reaches. Data gathered on this stream indicate that a smolt production rate of 33 smolts/redd can be expected. Therefore, these improvements can be expected to produce an additional 1,254 smolts, an 81% increase. In addition, increased pool area provided by the improvements can be expected to improve either the smolt/redd

ratio, the smolt to returning adult survival rate or both. Therefore, the 1,254 increase in smolt production can reasonally be considered conservative.

ABSTRACT

Deer Creek is a tributary of the South Fork John Day River (T. 16 S., R. 27 E.). This stream is an important summer steelhead spawning area providing 22% of the total accessible summer steelhead spawning area in the South Fork system. The Bureau of Land Management (BLM) administers the lower 2.9 miles. This reach is low in productivity in relation to the upstream reaches. Factors accounting for this include relatively high gradient which in turn has led to excessive water velocity, lack of pool area, and lack of spawning gravel. Data collected during 1981 showed 3503 fish per mile and 1.4 redds per mile in this reach. In August of 1981, a series of three log weirs and another series of one log weir, one single log deflector and one double log deflector, were constructed in Deer Creek. Data collected during 1981 showed 3931 fish per mile in these sections up from the 3503 fish per mile recorded in 1981 for the same sections and 3.0 redds per mile. While 1982 was overall a better spawning year for summer steelhead this improvement does seen to indicate the success of these improvements. In October of 1982, 22 more of these type structures and 100 boulders were placed in Deer Creek above Deer Creek Falls on BLM administered lands. These improvements were designed jointly by BLM and Oregon Department of Fish and Wildlife (ODF&W), constructed by BLM, and funded by the Bonneville Power Administration (BPA). Studies are ongoing to determine the effectiveness of these improvements.

INTORDUCTION

Deer Creek is a tributary of the South Fork John Day River (T. 16 S., R. 27 E.). This stream is an important spawning area for summer steelhead, providing 22% of the total accessible summer steelhead spawning habitat in the South Fork system. It is the single most important and extensive summer steelhead spawning area on BLM administered lands in the South Fork drainage, providing approximately 87% of the total accessible summer steelhead habitat under BLM control in the drainage. BLM administration is limited to the lower most 2.90 miles of Deer Creek. Of this distance 0.25 miles were rated as poor aquatic habitat and 2.65 miles as fair. Major limiting factors are excessive water velocities, lack of pool area and lack of spawning gravels.

Fish species found in the upper portion (upstream Deer Creek Falls) are limited to resident redband/rainbow trout and summer steelhead. Various non-game species also are found in the lower reaches. Electroshocking data for 1981 and 1982 showed a mean of 3503 and 3931 fish per mile respectively. Fork length of those fish indicated that most of these were juvenile summer steelhead. Redd counts made in 1981 and 1982 showed 1.4 and 3.0 redds per mile respectively. This is approximately one-fourth to one-half the level of spawning activity that occurs in this stream on National Forest lands upstream. The difference can be traced directly to the limiting factors discussed previously. Efforts have been made by the BLM to alleviate this situation. In 1979 Deer Creek Falls was modified to facilitate adult summer steelhead upstream passage. In 1981 four log weirs, one single log defector, and one double log deflector were contructed. These structures were to reduce water velocities, scour out rear pools, and allow for the deposition of additional spawning gravels. Overall goals were to increase both the spawning and rearing capacity of the stream. These structures are accomplishing the physical alteration as planned. Electroshocking and spawning survey data as discussed above seem to indicate these structures are also accomplishing the overall goals as well. In short, the results from these six structures encouraged the further improvement of the stream using these techniques as well as some new techniques utilized successfully on other streams.

PROJECT DESCRIPTION

The Deer Creek Steelhead Habitat Improvement Project undertaken by the BLM in 1982 and funded by BPA was an extension of the work described in the preceding section. Initial planning prescribed twenty log weir structures and 50 boulders. Subsequently, these numbers were changed due to on site design changes required by site characteristics hidden prior to actual construction and to the skill of the equipment operator allowing more work to be done in the same period of time. The completed project consisted of 10 log weirs, 3 boulder weirs, 4 double log deflectors, 3 single log deflectors, 2 log cutbank protectors, and 100 boulders. These structures were placed in a variety of configurations ranging from one or more log weirs to log weirs and double deflectors, to double and single deflectors. The configuration chosen depended on individual site characteristics including bank height, bed width, and bank composition.

All of the log weir structures were notched to allow upstream passage of age 1 (5 inch) summer steelhead and larger. Rearing pools were dug out below each log weir at the time of construction to a depth of approximately 18-24". Spring runoff will probably stabilize the depth to that which will be maintained by scouring forces generated by the structures.

The boulder weirs were constructed by placing four to six boulders (approximately 2-3 feet diameter) in a straight line across the stream. Each boulder was placed about 6 to 10 inches from its neighbor. This allows easy upstream passage of even the smallest fish while creating a drop at higher flows to scour out a pool downstream and trap gravel on the upstream side. The remaining boulders were placed more or less randomly along stream reaches lacking adequate depth and cover but where site characteristics did not allow the installation of log structures.

Following construction of the improvements disturbed areas were returned to natural contours as nearly as possible. These areas were then seeded with a mixture of orchard grass, crested wheatgrass, and yellow blossom sweet clover and covered with brush.

SUMMARY AND CONCLUSIONS

A total of 22 log or boulder structures were constructed and 100 boulders were placed in Deer Creek. With the exception of two single weirs all structures were placed in combination with other structures. These combinations included two weirs, three weirs, two cutbank protectors and a single log deflector, two single log deflectors with one double log deflector upstream and downstream of the single log deflectors, and two weirs with a double log deflector upstream and then another weir. The boulders were placed along two reaches with approximately 20 boulders placed along a reach near Round Creek and 80 boulders placed approximately 400 yards downstream of this reach.

Inspections as late as December 29 showed all structures to be operating as planned with no observed problems. The short term success (2-5 years) of the new designs (i.e. rock weir and cutbank protectors) will encourage their use along other reaches of the stream. The lower approximately 100 yards of Deer Creek can benefit from weirs and a series of weirs may be constructed in this reach in the future.

Structures completed in 1981 have been shown to be producing positive results. Both number of fish per mile and redds per mile have shown increases. These results are only preliminary and more data will have to be gathered during future field seasons to substantiate this. However, in the absence of other site specific data this data was used to estimate future production attributable to the improvements completed under this project. After a sufficient period of time has passed to allow full utilization of the improvements (probably 3-5 years) it is expected that they will account for an approxiamte 81% (1,254 smolts) increase in smolt production. This was based on 1,140 sq. yds. of newly deposited spawning gravels with 30 sq. yds. of suitable spawning gravel required for each pair of spawning summer steelhead. Additionally, it was assumed smolt production in Deer Creek equaled 33 smolts/redd based on a smolt to returning adult survival rate of 6%.

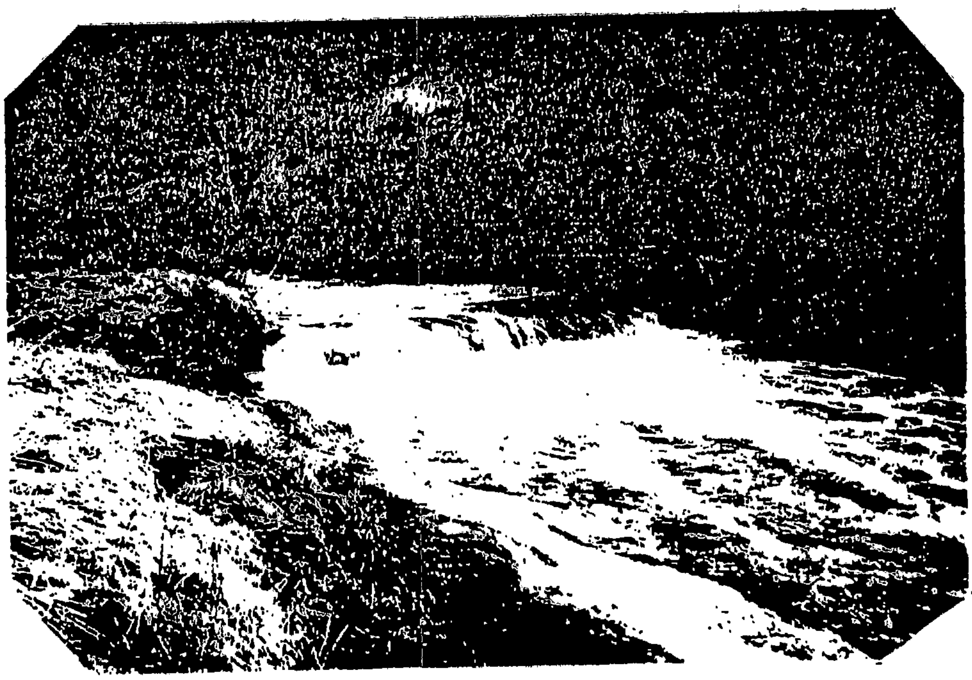
BALANCE SHEET

A.	Personnel	
	1. Work month related costs	$ 6788.64
	2. Vehicle useage	197.86
	3. Travel (Per diem)	531.00
B.	Contracts for Project Implementation	
	1. Log hauling	650.00
	2. Log weir installation & boulder placement	8592.50
	3. Blasting	6000.00
PROJECT TOTAL		$22,760.00

Natural boulder weir. This is the type of effect strived for.

Site 1 (Post)

A single log deflector diverts flow from the right bank. Two benefits are realized here: 1) in a section lacking pool area, a pool will be scoured at the end of the log as well as along the left bank (a rock bluff), and 2) a cutbank and willow clump (see arrow) is protected.



Site 1 (Post)

Immediately downstream previous pnoto. Two log weirs in series are creating two new pools and trapping spawning gravel which are both lacking here. Prior to placement the area below the downstream structure was a broad riffle providing very little in the way of rearing or spawning habitat.

Site 2 (Post)

Prior to placement this reach was a shallow riffle with little spawning and rearing area.

Site 3 (Pre)

Fair number of large rocks in this reach but shallow water depth severely degraded their benefits. Electroshocking areas such as this produces mostly Age 0+ fish with a very few older fish due to lack of useable habitat area.

Site 3 (Post)

Two structures were originally planned but far bank turned out to be a rock bluff. A natural pool exists here (see arrow). The constructed weir creates another pool as well as depositing spawning gravel. The rocks shown in the previous photo are now in deeper water making them more beneficial to juvenile fish.

Site 4 (Post)

Photo of all three structures. Two lower structures are log weirs and upper structure is a double log deflector. This reach prior to improvement was entirely riffle lacking pool area.

Site 4 (Post)

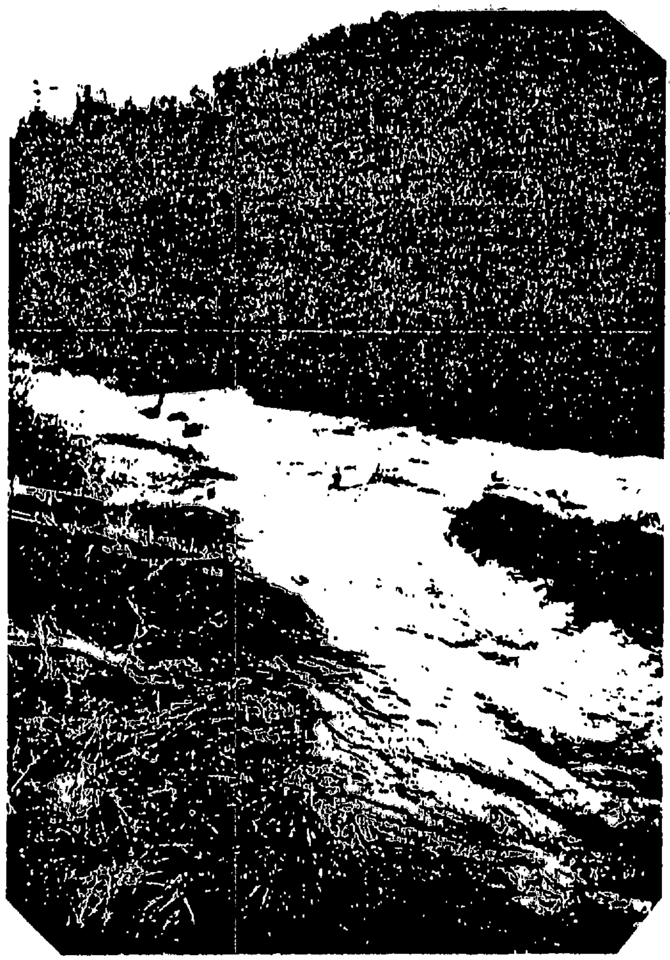
Middle structure of series. Note photo was taken during high water. Pool created by this weir will be shaded by willows.

Site 4 (Post)
Upper structure (double deflector) of series. Pool is being scoured out in center where white water is evident.

Site 5 (Pre)
Note shallow riffle nature of this site. Good riparian shading already exists, however.

Site 5 (Post)
Note upstream side shaded by willows.

Site 6 (Pre)
As with previous site, shallow, relatively unproductive riffle area but good riparian shading.



Site 6 (Post)

Note white water. This marks location of boulders placed in this section. Approximately 20 boulders were placed here. They will provide much needed pool area where low banks do not allow log weirs.

Site 7 (Pre)
Very similar to Site 6. Shallow riffle area with problem of late summer high water temperatures.

Site 7 (Post)
Approximately 15 boulders placed in this reach. Each of these boulders will scour out a hole immediately downstream as well as trapping spawning gravels. Inspections made in March show all boulder placements to be accomplishing designed task.

Site 7 (Post)

Prior to improvement this was a long, sweeping cutbank. Water was shallow with no instream structure. Treatment included a double log deflector at upper end (below pickup), followed by four single log deflectors around the outer edge of the bend, and ending with a double log deflector to return the flow to the center of the stream.

Site 7 (Post)

Double log deflector at beginning of section. Note far deflector. Originally, only a single log deflector was planned. However, a large log left from previous high water was present. This log was buried to extend its useful life at very low cost (approximately $15).

Site 7 (Post)
This photo shows two single deflectors with boulders which were placed with them to create additional habitat.

Site 7 (Post)
"V" of white water shows location of double deflector at end of section. This returned flow to center of stream to prevent erosion of far bank.

Site 8 (Post)

This shows the log weir which represents the first structure in a relatively long series. Prior to improvements this section was largely (~95%) shallow riffle with little rearing or spawning area. It looked very similar to Site 7.

Site 8 (Post)

This shows the second log weir in this series.

Site 8 (Post)
This photo shows an added benefit to these structures. Silt is deposited at the edge of the pooled water on the upstream side (see arrow).

Site 8 (Post)
Double log deflector. Log on right side is buried flush with low bank and heavily riprapped. This allows water to flow over keyway without damage. This technique is useful where high banks are not present.

Site 8 (Post)

This photo shows improvements to a shallow section abutting a rock wall. The single log deflector diverts flow into the wall scouring out a long pool.

Site 8 (Post)

Close up of previous structure.

Site 8 (Post)
Upstream log weir in the series. Diverts flow from far bank into center where erosion is lessened and pool area is created. Spawning gravel also trapped. Large boulders left below weirs as in picture enhance pool created.

Site 8 (Post)
Upstream reach of section improved. White water marks boulder placements. Prior to improvement this section was similar to Site 7.

Site 8 (Post)

Close up of boulder weir visible in upper left hand corner of previous photo. Usefull where conditions preclude use of log weir. Inspection in March showed results very similar to log weir.

Site 9 (Pre)

Note shallow riffle nature.

Site 9 (Post)
Note boulder weir in center of photo. This photo taken downstream.

Site 9 (Post)
Downstream boulder in this series. Prior to improvements entire section appeared as shown in Pre photo above.

Site 10 (Post)

Prior to improvement this section looked exactly like Site 7. Inspection in March showed a pool being scoured out by each boulder as well as gravel deposited around each boulder.

Site 10 (Post)

Boulder weir at upper end of section. Operating very similar to log weir.

MURDERERS AND DEER CREEKS HABITAT IMPROVEMENT

FINAL REPORT, 1983

By

Brady Green, Fishery Biologist
Malheur National Forest
John Day, Oregon

Funded by

Bonneville Power Administration
Division of Fish and Wildlife
Agreement No. DE-AI79-83BP11889
Project No. 83-384
Project Officer: Larry Everson

SUMMARY

During the summer of 1983, 118 single log weirs were constructed and 185 boulders were placed by the USDA Forest Service (USDAFS), Malheur National Forest, in Deer Creek, Murderers Creek, and Tex Creek (a tributary to Murderers Creek). Total cost of the project was $65,000, with $63,500 being financed through BPA and $1500 from USFS contributed funds. These structures were placed along two miles of Murderers Creek, one-eighth mile of Tex Creek, and five miles of Deer Creek (Fig. 1).

The primary objective was to increase and improve the quality of pool habitat in these streams using a combination of log weirs and boulders, thereby increasing the juvenile rearing capacity for summer steelhead trout (Figs. 2 & 3). Side benefits included spawning gravels collected above and below the weirs and benefits to the resident trout populations. The weirs create high quality, self-cleaning pools ideal for rearing juveniles. These pools provide cover primarily through depth and surface turbulence.

Assuming full utilization of the additional habitat created through the project, annual benefits are estimated at $18,309. Discounted at 4 percent for a 30-year project life, total benefits are estimated to be $250,140. The benefit/cost ratio for the project is 3.8:1. Due to the better than anticipated accessibilty and abundance of good rock for boulders and savings in other areas of the project, the unit cost per structure was lower than estimated. These factors allowed us to exceed the estimated target of 108 log weirs and 20 boulders.

DESCRIPTION OF PROJECT AREA

Murderers Creek (including Tex Creek), a tributary to the South Fork John Day River, supports 59 percent of the total spawning run of summer steelhead in the South Fork John Day River. Estimated run size (Forest only) for Murderers Creek is 293 spawning adults. Estimated smolt production on USDAFS land is 13,325 with an estimated potential for 42,835.

Deer Creek, also a tributary to the South Fork John Day River, supports 26 percent of the total spawning run of summer steelhead in the South Fork John Day River. Estimated run size (Forest only) for Deer Creek is 129 spawning adults. Estimated smolt production on National Forest land is 5,850 with an estimated potential of 26,325.

Stream habitat surveys conducted by the Oregon Department of Fish and Wildlife (ODFW) in 1960 and the Forest Service in 1981 indicated that rearing habitat, in the form of pools and cover, was lacking along most of these streams. Murderers Creek pool area averaged only 38 percent in the reach from Oregon Mine Creek downstream to Stewart Cabin, a distance of three miles. Pool area in Deer Creek below South Fork Deer Creek, a distance of eight miles down to the Forest boundary, averaged only 15 percent of the total surface area. Average summer pool depth for both streams was less than one foot.

DESCRIPTION OF ACTIVITIES

Project work was completed on August 26, 1983. The project required three contracts which included: 1) hauling of riprap - preparation, loading, and hauling of riprap to the project site; 2) preparation of logs for log weirs - cutting, decking, and hauling logs to project sites; and 3) equipment rental with operator - two backhoes with operators installed log weirs and placed boulders at selected sites in the project area. A crew of four was hired to assist the backhoes with the log weir construction portion of the project. Log weir and boulder sites were selected beforehand, using a combination of hydrologic and fisheries criteria.

All disturbed areas were seeded with grasses to speed up the recovery process.

ODFW is conducting a monitoring program on Deer Creek, financed by BPA, to help determine changes in steelhead population due to the installation of stream habitat improvement structures on Bureau of Land Management and Forest Service lands.

ECONOMIC ANALYSIS

Project Costs:

a.	Salaries	$25,141
b.	Travel and transportation	1,662
c.	Equipment and materials	8,456
d.	Contracts	
	Preparation, loading, hauling riprap	7,705
	Preparation of logs for log weirs	7,664
	Equipment rental with operator	12,873
	Total	$63,510

Project Benefits:

a. It is estimated that this project increased pool habitat by 84,383 square feet and will result in an increased steelhead annual smolt production of 7,760 (Table 1). These data are based on steelhead production and smolt habitat capability indices developed cooperatively with ODFW and the Malheur National Forest.

b. The adult steelhead production is estimated to increase by 155 adults (7,760 smolts x 2%[1] smolt/adult survival).

This is estimated to result in 51 additional adult steelhead escaping to spawn on the Forest (155 adults ÷ 33%[2] escapement).

c. Total estimated annual steelhead benefit is $18,309 (51 adults x $359/escaping spawner[2]). Benefits for a 30-year project life discounted at 4 percent are $250,140.

$$\frac{\text{Net present benefit} = \$250{,}140}{\text{Net present cost} = 65{,}000} = \frac{3.8}{1} = \frac{B}{C}$$

[1] Based on ODFW steelhead life history studies on Tex Creek, 1960-1965.

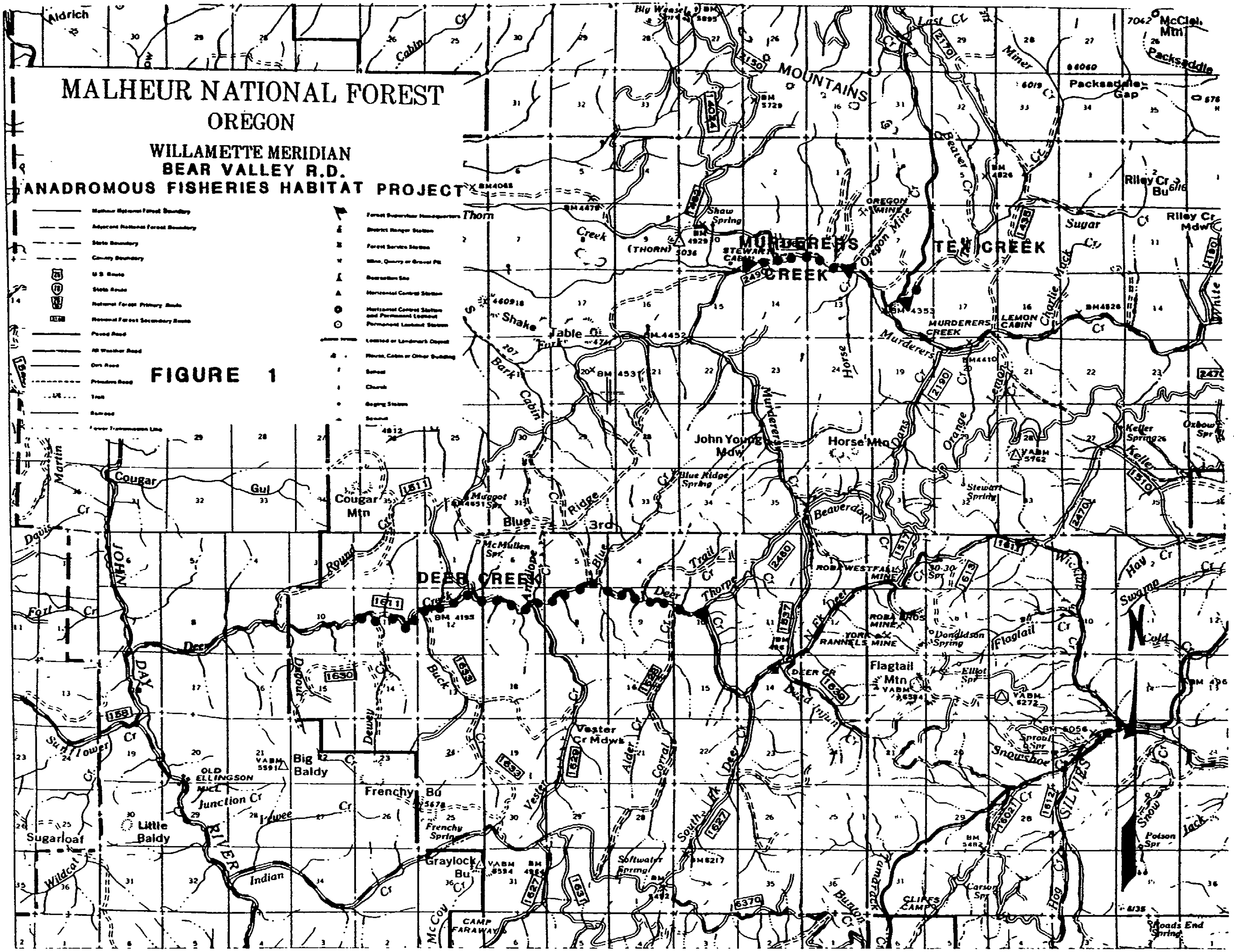
[2] Based on figures for escaping Columbia River steelhead trout in "Net Economic Values for Salmon and Steelhead from the Columbia River System," by Philip A. Meyer, NOAA Tech. Memo, NMFS F/NWR-3, 1982.

Table 1. Physical Habitat and Smolt Production Changes due to Habitat Improvements in Tex Creek, Murderers Creek and Deer Creek.

	Total Stream Surface Area (ft^2)	Total Area in Pools before Improvement (%)	(ft^2)	Optimum Area in Pools* (ft^2)	Pool Area Lacking (ft^2)	Stream Miles Improved (mi)	$\bar{x}$ Width of Stream (ft)	Area Created per Weir** (ft^2)	No. Weirs Constructed	Area Created by Weirs (ft^2)	Area Created per Boulder (ft^2)	No. Boulders Placed	Area Created by Boulders (ft^2)	Total Area Created with Project (ft^2)	Total Area in Pools after Improvement (%)	(ft^2)	Total Predicted Smolt Gain with Project
Tex Cr.	5,491	36	1,977	3,295	1,318	.13	8	536	2	1,072	-	-	-	1,072	56	3,049	299
Deer Cr.	264,000	15	39,600	158,400	118,800	5	10	667	94	62,698	15	135	2,025	64,723	40	104,323	4,650
Murderers Cr.	126,720	38	48,154	76,032	27,878	2	12	804	22	17,688	18	50	900	18,588	53	66,742	2,811
Totals	396,211	-	89,731	237,727	147,996	7.13	-	-	118	81,458	-	185	2,925	84,383	-	174,114	7,760

*Many areas which were lacking in pool habitat were not improved because of accessibility problems or the damage that would have occurred to riparian vegetation was unacceptable, so this optimum is theoretical based on maximum accessibility to all reaches of the stream. The optimum habitat for steelhead rearing is 60% of the surface area in pools and 40% in riffles.

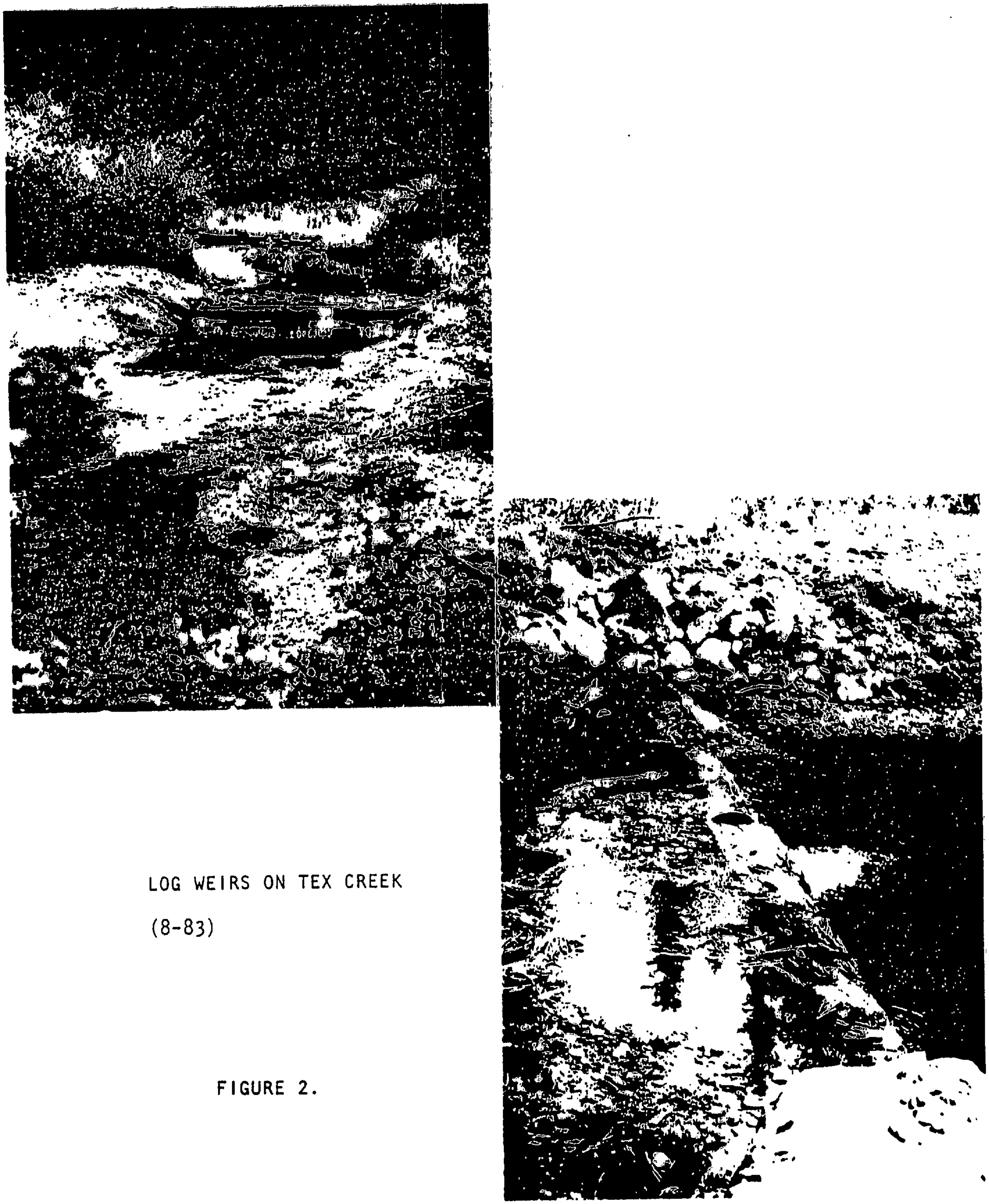
**The average length of pools created was estimated to be 67 feet based on an average stream gradient of 1 1/2% in the three streams. Some pools were shorter where gradient exceeded 1 1/2% while some were larger where gradient was less than 1 1/2%.



T. 15 S.

T. 16 S.

R.26 E. R.27 E. R.28 E. R.29 E.



LOG WEIRS ON TEX CREEK

(8-83)

FIGURE 2.

BOULDER PLACEMENT-MURDERERS CREEK

(8-83)

FIGURE 3.